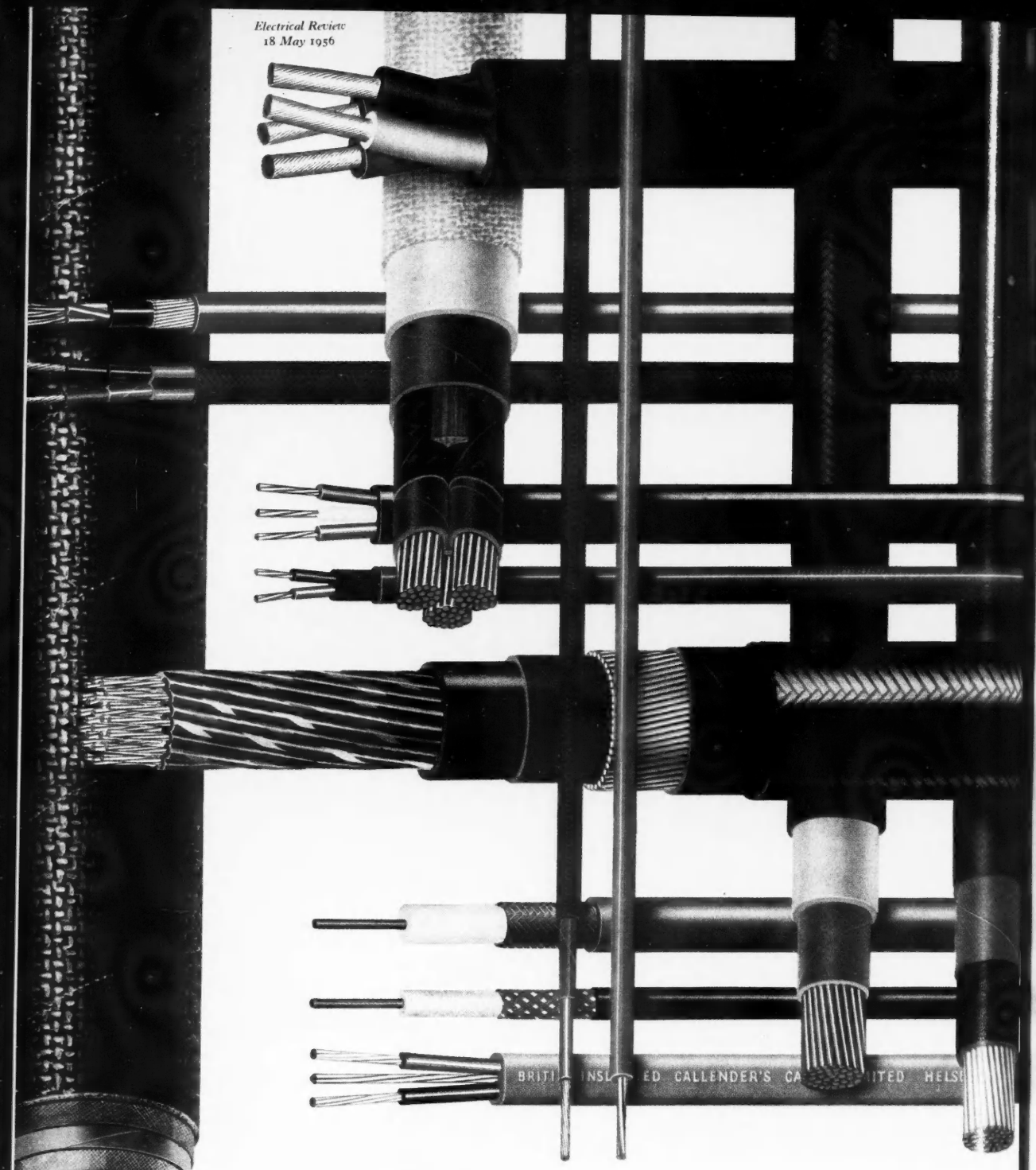
ELECTRICAL REVIEW



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ELECTRICAL REVIEW

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18 MAY 1956

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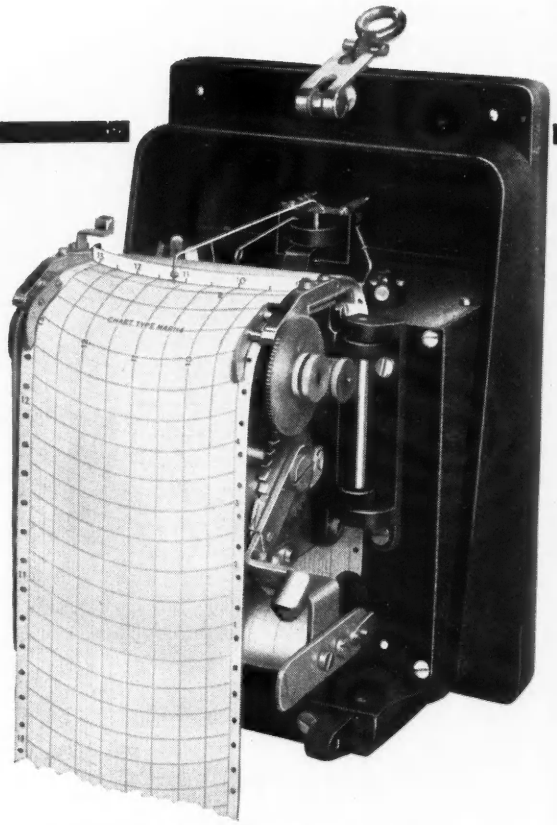

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ELECTRICAL REVIEW

18 May 1956 Vol. 158 No. 20 Established 1872

Next Week's Convention

A RECORD attendance is expected at the British Electrical Power Convention which opens at Torquay next Wednesday under the presidency of Sir John Dalton. The Convention is the only opportunity available to all sections of the electrical profession and industry for getting to know one another and discussing matters of common interest. There is sometimes a querulous suggestion that the social side of the Convention is overdone but it could easily be argued that it is, if anything, more important than the " business " aspect.

Another matter which appears to need stressing every year is the nature of the constitution of the Convention. As readers know, it sprang from the well-established I.M.E.A. Convention but at the same time its character was changed. Instead of being a purely electricity supply affair, as the I.M.E.A. Convention was, all sections now sponsor the event and have a voice in its management. Naturally on account of their size the electricity supply and electrical manufacturing sections take a predominant part and so far (with one notable exception) the presidency has alternated between them. The exception was Mr. J. R. Beard, the eminent consultant, and there seems to be no reason why there should not be similar departures from the general rule in the future.

It has been the custom to have a Convention " theme " and although on one or two occasions the " terms of reference " have been fairly wide, it is as well to give the proceedings some sort of coherence in this way. The earlier themes were mainly related to electricity supply—a natural thing for the transitional period. In 1949 the theme was " Transmission and Distribution," in 1950 " Generation " and in 1951 " Utilisation." The 1952 theme was " Research " and subsequently the scope was expanded to " Electricity and National Prosperity " (1953), " Electrical Industry at Home and Overseas " (1954) and " Electricity and the Future " (1955).

This year nine of the ten papers deal with various facets of electric rail and road transport. Although this may appear to be a specialised theme, the subjects are quite varied and are likely to interest a number of widely-different people. Railway traction equipment takes the leading part in the symposium but there are also papers on substation plant, signalling, and electricity supply considerations, as well as one on Commonwealth railway electrification. In line with the Convention theme we publish in this issue articles tracing the development of railway electrification and electric road transportation.

Domestic electricity is always a subject at the Convention whatever the main theme may be. This element is to be provided at Torquay by Mr. D. Bellamy, chairman of the British Electrical Development Association, in a paper on " The Domestic Consumer." This will link up with an all-electric bungalow which E.D.A.

has erected in the grounds of Torre Abbey as a part of the electrical exhibition, which is again an important feature of the Convention.

In 1952 it was decided to introduce an "Electrical Forum" at which a panel of knowledgeable people answered questions sent in by delegates. This has been continued at each succeeding Convention and has provided a feast of wit and wisdom, highly appreciated by the large audiences which it attracts. Given reasonably good weather, we are safe in predicting that next week's Convention at Torquay will be at least as successful as its forerunners.

INDIAN POLICY

Since India achieved self-government the position held by this country in Indian trade and industry has become much less favourable. Indeed it has sometimes seemed that the Indian Government has gone out of its way to assert its independence of Great Britain economically as well as politically. In fact the market has been thrown open and British concerns have been able to succeed only by offering better value than their competitors.

The recent announcement regarding industrial policy by the Indian Government shows that both British and non-British enterprise will be dispensed with to a growing extent as time goes on. The decision to make the future development of basic industries the sole or main responsibility of the State covers the production of heavy electrical plant, railway transport, telephone apparatus and cables, the generation and distribution of electricity, and telegraph and radio apparatus (not receivers). Private industry is allotted partnership with the State in another sector and in a third category will be allowed to operate independently. It is the Indian Government's policy to encourage native industrial development and so the field left to foreigners will be considerably narrowed. It is unlikely, however, that self-sufficiency will be attained for some years and India will continue to look to this country (among others) for equipment and practical advice.

"CONSCRIPTED" TECHNOLOGISTS

We think a point in his presidential address "The Technological Awakening" given recently to the Institution of Chemical Engineers by Mr. John A. Oriel, C.B.E., is worth comment in that it shows the futility of making comparisons between the number of technologists in this country and those in other countries, particularly the United States and Russia. For one thing our way of life is different from that of either of these other countries.

Quoting the Prime Minister, Mr. Oriel said that the Russians could direct graduates into any job for which there was a need at the moment and, in fact, at present and for the next few years, as many as 80 per cent of their scientific and technological graduates were being directed into the teaching profession. He said that we did not wish to follow the Russians in forcing men to adopt scientific or technological careers, but we could hardly say that we did not force men at all. We were at present forcing all our graduates, who were badly needed, into two years of National Service. It was clearly foolhardy to allow those men who had been chosen on account of their ability for special training in science and technology to waste two years at a time when they were urgently required at home and abroad working in their own profession.

COLOUR IN LIGHTING

The discussion on the paper by Dr. J. W. Strange and Mr. H. Hewitt, "Light and Colour in Daily Life," presented last week at the Illuminating Engineering Society's Summer Meeting at Harrogate (reported in this issue) brought out the point that there was more colour in lighting 25 years ago than there is to-day.

We are inclined to agree with this and with the explanation that it is probably because of our concern in correcting colour as the result of the introduction of various types of discharge lamps. What we felt was missing in both the paper and the discussion, however, was a distinction between coloured light sources such as the festoons along the sea front and coloured surfaces on the stage. Both of these come under the heading of "effect" lighting which is not generally called for under ordinary living conditions, say, in the home, office, shop, etc. But that is not to say that a little colour by way of both the light source and the lighted surface is not a welcome thing, for as the authors pointed out, lighting in the home can be made more pleasant by the judicious use of colour without serious loss of efficiency.

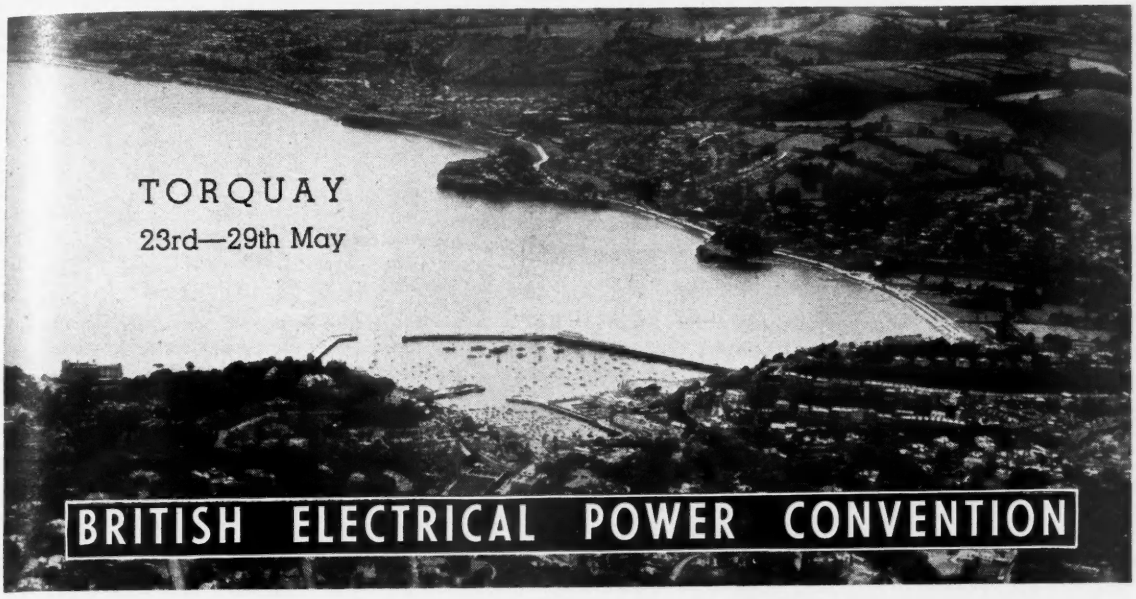
MERCURY OR SODIUM?

Much was said in the paper "Relative Brightness of Coloured Light Sources" presented by Messrs. Ferguson and Stevens at the I.E.S. Summer Meeting about the relative merits of both mercury and sodium lighting for roads. Observers' impressions of glare and surface illumination were summated and presented in table and graph form.

All this reminds us of visits we made to demonstrations of both forms of lighting on suitably equipped stretches of roads in various parts of the country over twenty years ago. The uncertainty to-day, judging from the paper and the discussion it provoked, is just as great as it was in those earlier days; indeed it may be more so in view of the "narrowing of the errors" which has been brought about by the corrective lighting which has been effected in most types of lamp since their introduction. There is no uncertainty, however, in the weight of public opinion which has been produced during the two or three decades as the results of the use of different forms of lighting in adjacent areas. This is that uniformity of road surface lighting is of much greater importance than is the question of what form of lighting illuminates the road surface best.

POWER CONVENTION

Next week's *Electrical Review* will contain a portrait in colour of Sir John Dalton, President of the British Electrical Power Convention, with an abstract of his address. Another feature will be an article on electrical progress in South West England by Mr. H. D. B. Wood, O.B.E., secretary of the South Western Electricity Board



ON Wednesday next, 23rd May, the eighth British Electrical Power Convention begins at Torquay with the opening by the President, Sir John Dalton, M.I.E.E., F.C.I.S., of the Electrical Exhibition, organised by the British Electrical Development Association, a pre-view of which is presented in this issue. The theme this year is "Electricity and Transport" and, as will be seen from the programme reproduced below, nine papers on various aspects of electric rail and road transport will be read and discussed. As the domestic side of electricity is always represented at the Convention there will be a tenth paper on "The Domestic Consumer." That popular feature the "Electrical Forum" is to be repeated and there are the customary social functions. At the Convention dinner on 28th May the principal guest and speaker will be Lord Brabazon of Tara, P.C.

THE CONVENTION PROGRAMME

WEDNESDAY, 23rd MAY

9 p.m. *Torre Abbey Meadows.* Official opening of the Electrical Exhibition by the President, Sir John Dalton, M.I.E.E., F.C.I.S.

THURSDAY, 24th MAY

10 a.m. *Pavilion.* Opening of the Convention and civic welcome by the Mayor of Torquay, Councillor Isidore Joseph, J.P. Presidential Address by Sir John Dalton.

3 p.m. *Torre Abbey* (Entrance in Chestnut Avenue). Ladies' Tea. To meet Lady Dalton.

8 p.m. to 12.30 a.m. *Town Hall.* Reception by the Mayor and Mayoress of Torquay followed by dancing.

FRIDAY, 25th MAY

10 a.m. *Pavilion.* Papers on Electricity and Transport.

(1) "Electricity in Rail Transportation," by S. B. Warder, M.I.Mech.E., M.I.E.E., M.I.Loco.E., chief electrical engineer, British Transport Commission, British Railways Division. Discussion.

(2) "Electricity Supply and the Railway Load," by F. J. Lane, O.B.E., M.Sc., M.I.E.E., deputy chief engineer (transmission), Central Electricity Authority, and W. B. Noddings, M.Eng., M.I.E.E., chief commercial officer, Central Electricity Authority. Discussion.

2.30 p.m. *Pavilion.*

(3) "Electricity in Locomotives," by C. M. Cock, M.I.Mech.E., M.I.E.E., A.M.I.E.Aust., M.I.Loco.E., general manager, Traction Department, English Electric Co., Ltd.

(4) "Electric Multiple Unit Trains and Equipment," by F. A. Manley, manager, Traction Department, General Electric Co., Ltd.

(5) "Electric Signalling Systems for Rail and Road Transport," by D. G. Shipp, B.Sc., M.I.E.E., M.I.R.S.E., assistant manager, Signalling Division, Westinghouse Brake and Signal Co., Ltd. Discussion.

SATURDAY, 26th MAY

10 a.m. *Pavilion.*

(6) "Railway Electrification in the Commonwealth," by E. L. E. Wheatcroft, M.A., M.I.Mech.E., M.I.E.E., and H. H. C. Barton, B.A., M.I.Mech.E., M.I.E.E., M.I.Loco.E., M.Inst.T., of Merz & McLellan.

(7) "Sub-Station Equipment for Road and Rail Systems," by G. S. Causon, A.M.I.E.E., director and joint manager, Hackbridge & Hewittic Electric Co., Ltd., and F. G. Stevens, A.M.I.E.E., rectifier sales manager, Hackbridge & Hewittic Electric Co., Ltd. Discussion.

Golf Competitions in aid of the Electrical Industries Benevolent Association will take place during the afternoon.

SUNDAY, 27th MAY

8 p.m. *Pavilion.* Popular Concert.

MONDAY, 28th MAY

10 a.m. *Town Hall.* "The Domestic Consumer"—with demonstrations—presented on behalf of the British Electrical Development Association by D. Bellamy, O.B.E., D.L., F.A.C.C.A., F.C.W.A., Companion I.E.E., chairman of E.D.A., and chairman, Yorkshire Electricity Board. Discussion.

1 p.m. *Callard's Cafe*, Fleet Street. Rotary Club Luncheon.

2.30 p.m. *Town Hall.* "Electric Passenger Road Vehicles," by J. H. Cansdale, M.I.E.E., M.I.Loco.E., deputy manager—contracts, Traction Department, British Thomson-Houston Co., Ltd. Discussion.

"Battery Electric Vehicles," by H. W. Heyman, B.Sc.(Hons.), M.I.E.E. (Smiths Delivery Vehicles, Ltd.), P. Rochs (Austin Crompton Parkinson Electric Vehicles, Ltd.), and H. R. Simpson, A.M.I.Mech.E. (T. H. Lewis, Ltd.), presented on behalf of the Electric Vehicle Association of Great Britain by V. W. Dale, Companion I.E.E., chairman of the Association.

7 for 7.30 p.m. *Palace Hotel.* Annual Dinner. Chief guest, Lord Brabazon of Tara, G.B.E., M.C.

9 p.m. to 1 a.m. *Town Hall.* Dance and Cabaret.

TUESDAY, 29th MAY

10 a.m. *Pavilion.* Electrical Forum.

12 noon. *Pavilion.* Annual General Meeting.

Constitution of the Convention

NOTES ON SPONSORING ORGANISATIONS

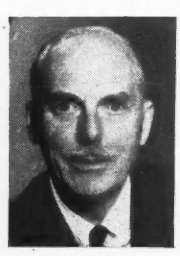
Sir John Dalton is President of this year's Convention

For over half a century one of the principal electrical events of the year was the annual Convention of the Incorporated Municipal Electrical Association. Delegates to this gathering were local authority electricity committee chairmen and their electrical engineers but there were many invited guests from other sections of the electrical industry.

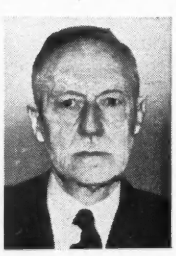
When nationalisation of electricity supply brought the I.M.E.A. to an end, the chairman of the new British Electricity Authority, Lord Citrine, expressed the wish that the Convention should continue. The final I.M.E.A. Convention was held in 1948 and it was then decided that an annual meeting representative of all branches of the electrical profession and industry should be organised and a council was set up for this purpose with Mr. J. W. Simpson, the former secretary of the I.M.E.A. and organiser of its Conventions, as secretary. The first of the new Conventions was held at Torquay in 1949 and next week's gathering is therefore the eighth. There follow brief descriptions of the organisations sponsoring the Convention.

Association of Consulting Engineers

Proposals for forming an Association of Consulting Engineers were made in 1908 and after various discussions between Messrs. Handcock and Dykes, Sir Alexander Kennedy, Sir William Preece and Mr. Swinburne, an inaugural meeting was held in 1910 under the chairmanship of Sir William Preece, when it was decided to take the necessary steps to bring the Association into being. The memorandum and articles of association were signed in 1913.



Mr. J. S. Tritton



Col. C. W. G. Walker

The Association was formed with the object of promoting the advancement of consulting engineers by bringing together for consultation and co-operation those engineers whose work was of a purely consultative character, and of providing facilities for the Government, public bodies, trade associations and others to confer with consulting engineers and ascertain their collective views. One of the primary objects of the Association was to secure that persons undertaking to advise public and private bodies on engineering matters should be fully qualified technical engineers who were unconnected directly or indirectly with any manufacturing or contracting interest likely to prejudice their position as independent professional advisers.

The Association at the time of its formation had eighty members; there are now over four hundred. Members must normally be corporate members of the Institutions of Civil, Mechanical or Electrical Engineers but, in special cases, members belonging to other professional institutions can be elected.

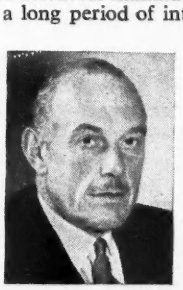
The present chairman is Mr. Julian S. Tritton, M.I.C.E., M.I.Mech.E. (Rendel, Palmer & Tritton) and the secretary is Colonel C. W. G. Walker, C.M.G., D.S.O.

British Electrical and Allied Industries Research Association

Born of the spirit of co-operation developed during the 1914-18 war when the I.E.E. and manufacturers established joint technical committees to deal with pressing problems of common interest, an Electrical Research Committee was established in 1917 and incorporated in 1920 under the title the British Electrical and Allied Industries Research Association, securing a D.S.I.R. grant. The original supporters, the B.E.A.M.A., the C.M.A. and the I.E.E. were joined by the electricity supply undertakings. The supply industry became the principal industrial contributor and the nationalised industry is the biggest contributor to-day. By 1935 the special facilities given to the E.R.A. staff by power companies and others proved insufficient and a laboratory was built at Perivale, which in its turn is now being replaced by the new laboratories at Leatherhead, the first stage of which is costing £400,000. The president is Lord Citrine, P.C., K.B.E. The director, Dr. S. Whitehead, died earlier this month and his successor has not yet been appointed.

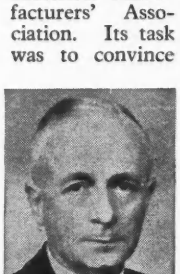
British Electrical and Allied Manufacturers' Association

In 1911, when the electrical manufacturing business had been weakened by a long period of internal strife and had lost ground in the face of intense foreign competition, the British Electrical and Allied Manufacturers' Association was incorporated, taking over the affairs of the National Electrical Manufacturers' Association. Its task was to convince

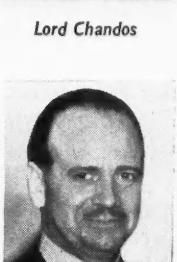


Lord Chandos

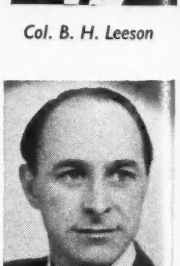
Col. B. H. Leeson



Mr. E. H. Ball



Mr. D. M. Buist



Mr. J. Oldroyd

manufacturers that the best interests of the industry would be served by voluntary co-operation, and it set out to build up a British electrical manufacturing industry and to export its products.

It began by establishing contact with the Government and kindred organisations. It co-operated with the I.E.E. on such matters as its Model General Conditions of Contract, and later the B.E.A.M.A. Conditions of Sale were prepared. It was instrumental in the founding of the E.D.A. and the British Electrical and Allied Industries Research Association and it initiated the World Power Conference in 1924. It established standard specifications and was instrumental in setting up the British Standards Institution.

The B.E.A.M.A., in conjunction with the Department of Scientific and Industrial Research, sponsored the Association of Short-Circuit Testing Authorities to combine switchgear testing facilities. The work of the many B.E.A.M.A. committees indicates its multifarious activities, including materials, education, export, production, research, electricity development, contract conditions, standardisation, taxation and traffic.

The president is Lord Chandos, D.S.O., M.C., the director is Col. B. H. Leeson, C.B.E., T.D., M.I.E.E., and the export director is Mr. D. Maxwell Buist, M.I.E.E. Mr. E. H. Ball, M.I.E.E., is the chairman of the B.E.A.M.A. Council and Mr. J. Oldroyd, T.D., M.A., F.C.I.S., is the secretary.

British Electrical Development Association

When the British Electrical Development Association was founded in 1919, the aim of Mr. J. W. Beauchamp (the first director) and the dozen founder members, who represented all sections of the electrical industry, was to sell electricity. This was the first attempt to form a central publicity organisation to educate the public in the great possibilities of electricity, at a time when electricity was available to only just over 14 per cent of the country's area. Within a year, with a staff of only five and despite a far from satisfactory financial basis, E.D.A. had commenced publishing in the national Press; produced thirty publications; established special committees on rural electrification, industrial heating, tariffs, assisted wiring, etc.; and inaugurated the E.D.A. salesmanship conferences.

Mr. V. W. Dale

By 1925 it had quadrupled its subscription basis. Films, lectures, nation-wide campaigns followed and E.D.A. was leading the supply industry at all the national exhibitions. In 1935 E.D.A. parted company with the manufacturers, wholesalers and contractors, as it was seen that its functions were more properly allied to and managed by the electricity supply industry. The Council now consists of representatives of the Central Electricity Authority and Electricity Boards.

The president for 1956-57 is Viscount Chandos, the chairman of the Council is Mr. D. Bellamy (chairman, Yorkshire Electricity Board) and Mr. Victor W. Dale is director and secretary.

British Refrigeration Association

This Association is the national body representative of manufacturers and distributors of refrigeration equipment and of insulating contractors. Each branch of the industry has its own section within the Association, that for the manufacturers of refrigeration machinery being divided into separate sub-sections for domestic, commercial and industrial equipment. The Association also has a form of membership for firms closely associated with the industry, such as manufacturers of specialised components. The industry regularly exports half its total output to practically every foreign market and consequently in addition to representing the industry in the home market, representing it in the field of foreign trade is an important activity of the Association.

Mr. R. G. Brandon

Mr. T. Whittaker

The present chairman is Mr. R. G. Brandon (Coldrator Division of the Hotpoint Electric Appliance Co., Ltd.) and the vice-chairman is Mr. D. S. Carruthers (L. Sterne & Co., Ltd.); the director is Mr. Thomas Whittaker, barrister-at-law.

British Valve Manufacturers' Association

The formation of the British Valve Manufacturers' Association originated in a round table conference of twenty-two manufacturers held in 1939 under the chairmanship of Mr. E. Bruce Ball, of Glenfield & Kennedy, Ltd., who died in 1944. The Association was called the British Iron and Steel Valve Manufacturers' Association until 1942 when it was decided to extend the membership to include manufacturers of non-ferrous industrial valves and fittings and the present title was adopted.

Mr. P. S. Ham

The main objects of the Association, which have varied but slightly since its inception, are: to promote the welfare and prosperity of its members; to afford advice and assistance to them in connection with valve business; to provide facilities for the discussion of questions affecting their interests; and to establish a channel for receiving from, and providing to, Government Departments or other bodies, information affecting the interests of the industrial valve industry.

Under many distinguished chairmen, the Association has grown steadily to the present total of sixty members. The present chairman is Mr. P. S. Ham, managing director of Ham, Baker & Co., Ltd. The Association may be said to be fully representative of the British valve industry, the value of whose output increased from just over £17 million in 1949 to nearly £30 million in 1955. One-third of its production is exported each year.

Cable Makers' Association

This Association was founded in 1899 for regulating the standards and maintaining the qualities of insulated cables of British manufacture. The present membership is sixteen and consists of manufacturing firms directly engaged in the cable industry who are members of affiliated associations.

Soon after its formation the Association drew up standard lists of conductors, thicknesses of dielectric, thicknesses of lead, sizes of armouring, etc., which were adopted throughout the world as standard practice. In 1904 the Engineering Standards Committee (now the British Standards Institution) issued a report on copper conductors which was drawn up with the co-operation of the Cable Makers' Association, and to a large extent embodied the original standards promulgated by the Association; from that date onwards the C.M.A. has co-operated in the preparation of the successive standards which have been issued.

Mr. R. W. C. Reeves

Mr. A. H. Carmichael

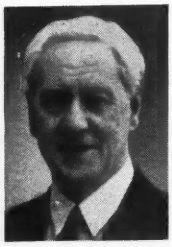
The Association has devoted attention to systematic research as a means of securing and maintaining the highest standard of quality in all classes of cable.

For almost forty years, a Joint Industrial Council for the whole cablemaking industry has been operative. This industry—largely at the instigation of the C.M.A.—has the distinction of being one of the first to establish regular joint consultation machinery on a voluntary basis. No insoluble industrial dispute has arisen in the industry during the whole period of the existence of the J.I.C.

The chairman of the C.M.A. for 1956 is Mr. R. W. C. Reeves, of Johnson & Phillips, Ltd., and the director is Mr. A. H. Carmichael.

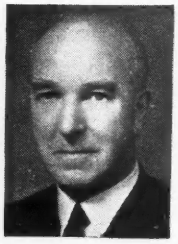
Central Electricity Authority

By the Electricity Act of 1947 the whole of the electricity supply of England, Wales and Southern Scotland was placed under the control of public boards. The British Electricity Authority was established to take over the generation and main transmission of electricity and to supply power in bulk to fourteen Electricity Boards. For this purpose, the country was divided into fourteen generating divisions under divisional controllers and for each division there was a corresponding but entirely separate electricity area with its own board. Since 1948 the number of divisions has been reduced to eleven by the amalgamation of two existing divisions and the separation of the two Scottish divisions. Similarly there are now only twelve Electricity Boards and in consequence of these changes the B.E.A. has become the Central Electricity Authority. The C.E.A. consists of a chairman (Lord Citrine), two deputy chairmen (Sir Henry Self and Mr. J. Eccles), two part-time members (Dame Caroline Haslett and Lt.-Col. E. H. E. Woodward) and four of the Electricity Board chairmen who serve two-year terms in rotation. The Authority owns about 21,000 MW of plant and about 5,600 route-miles of main transmission lines. During the year ended 31st March last its sales of electricity totalled over 70,000 million kWh.



Lord Citrine

Sir Henry Self



Mr. J. Eccles

Electricity Boards

Each of the twelve Electricity Boards has a full-time chairman and deputy chairman and six or seven part-time members. Generally the areas are divided into sub-areas each with its manager, which in turn are divided into districts. The Boards purchase electricity in bulk from the C.E.A. and are responsible for its distribution and for service to the consumers, which includes the operation of showrooms, advice on the various uses of electricity and installation work.

Electric Lamp Manufacturers' Association

The Electric Lamp Manufacturers' Association of Great Britain, Ltd., was formed in 1919 as a public company trading without profit; it embodied two of its predecessors, the British Carbon Lamp Association, formed in 1905, and the Tungsten Lamp Association, founded in 1911. In 1933 its members formed a new association, which complied with the legal requirements of a trade union and became E.L.M.A., as it is known to-day.

Its objects are (a) to promote, foster and protect the interests of the public, the trade and the producers, in the use, sale and manufacture of electric lamps; and (b) to promote and facilitate all agreements between the members which provide for all or any of the following purposes:—The interchange of scientific knowledge and experience resulting from research; the more advantageous use of their manufacturing facilities; the attainment and maintenance of uniformly high quality of electric lamps; the promotion of more efficient methods of illumination; the scientific and wider use of electric lamps; and the standardisation of electric lamps and the development of more efficient methods of manufacture and distribution.

Chairmen of the Electricity Boards

Mr. C. T. Melling (Eastern)

Mr. C. R. King (East Midlands)

Mr. H. J. Randall (London)

Mr. D. H. Kendon (Merseyside & N. Wales)

Mr. W. S. Lewis (Midlands)

Mr. T. M. Ayres (North Eastern)

Mr. T. E. Daniel (North Western)

Mr. N. Elliott (South Eastern)

Mr. L. Howles (South Wales)

Mr. A. N. Irens (South Western)

Mr. R. R. B. Brown (Southern)

Mr. D. Bellamy (Yorkshire)

Co-operative effort among E.L.M.A. members in research and manufacturing facilities has aided the development of the tungsten filament and fluorescent lamps. The Lighting Service Bureau was set up in 1924 to act as a centre for lighting demonstrations, propaganda and educational work. The chairman of E.L.M.A. is Mr. V. C. H. Creer, M.A., and the director is Mr. W. J. Jones, M.Sc., M.I.E.E. Mr. E. B. Sawyer is manager of the Lighting Service Bureau.

Mr. V. C. H. Creer

Mr. W. J. Jones

Mr. E. B. Sawyer

Electric Light Fittings Association

This organisation was formed in 1926 by nine manufacturers, including the British Thomson-Houston Co., Ltd., Falk, Stadelmann & Co., Ltd., the General Electric Co., Ltd., C. Harvey & Co., Metro-Vick Supplies, Ltd., and the Siemens & English Electric Lamp Co., Ltd. Initially decorative fittings were the main subject of interest but the Association has expanded and developed greatly since then, and now includes 35 members and three separate sections —Decorative Fittings, Industrial and Commercial Fittings,

Mr. C. J. W. Scott

Mr. Felix A. Rogers

Mr. J. H. Campion

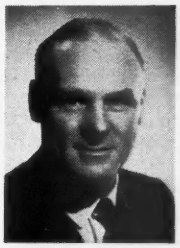
and Street Lighting. Each controls its own trading arrangements under the general direction of the Council.

The products of various members include fittings for every kind of lighting, including transport. Many of the members provide technical advisory services, supported by laboratories, and prepare complete lighting schemes; many design fittings for special applications and co-operate with the architect or consulting engineer from the planning stage. The Association's trading policy is based on a belief in the value of competition, based on fair trading principles. On the technical side E.L.F.A. does much to promote high standards of design and standardisation, being represented on over 50 B.S.I. Committees and on the national committees of bodies such as the I.E.C. and C.E.E.

Mr. C. J. W. Scott is president, Mr. Felix A. Rogers, M.B.E., is the director and Mr. J. H. Campion, T.D., B.A., the secretary.

Electric Vehicle Association of Great Britain

The Electric Vehicle Association of Great Britain, Ltd., started its life as the Electric Vehicle Committee in 1913 under the auspices of the Incorporated Municipal Electrical Association (I.M.E.A.). In 1934 it was registered as a private limited company, and in 1938 it became an Association under the chairmanship of Mr. J. B. Osler, O.B.E., M.Inst.T., who also acted as trustee along with the late Mr. F. Ayton, M.I.E.E., and Col. G. D. Ozanne, M.C., M.I.E.E. The secretary at that time was Mr. A. C. Cramb, M.I.E.E., M.I.Mech.E.; he was succeeded by M. V. W. Dale, Companion I.E.E., who is now chairman.



Sir Wavell Wakefield

The objects of the Association have always been to encourage, develop, and protect the electric vehicle industry in this country, and to further the use of and demand for these vehicles for industrial, commercial, and other purposes. To-day the Association's membership consists of manufacturers of all types of battery-electric vehicles, and makers of batteries, chargers, and accessories for those vehicles. Distributors of electric vehicles are also represented as associate members.

The president of the Association is Sir Wavell Wakefield, M.P.

Electrical Association for Women

"Electricity for Everywoman" was the idea which prompted the establishment of the Electrical Association for Women in 1924, for a group from the Women's Engineering Society, headed by Miss (now Dame) Caroline Haslett, thought that the women of the country should be acquainted with the benefits that would ensue from the application of electricity to the home. The E.A.W. also realised the need, for this purpose, of trained and efficient demonstrators and saleswomen. Courses of instruction were arranged and a Certificate and Diploma in Electrical Housecraft were instituted, to be followed later by similar arrangements for teachers of domestic science. The E.A.W. Training and Diploma Committee also became engaged in finding suitable posts and in pressing for an appropriate salary scale for demonstrators, for whom an annual conference in London was arranged with the British Electrical Development Association to enable them to keep abreast of new developments.

A Home Workers' Course, to give simple instruction in the use and maintenance of domestic electrical apparatus, was instituted for housewives and paid home workers and was later extended to schools and youth organisations. The Caroline Haslett Trust, awarding scholarships and travelling exhibitions is a prominent feature of all this educational work. National campaigns, lectures, visits, exhibitions, conferences and special courses arranged in co-operation with local electrical and educational authorities have all helped to further the aim of the Association which now has 160 branches and 1,200 members. The Dowager Lady Swaythling, O.B.E., is president of the E.A.W. and Dame Caroline Haslett, D.B.E., J.P., is the director and secretary.

Lady Swaythling

Dame Caroline Haslett

Electrical Contractors' Association

Incorporated in 1904 from the National Electrical Contractors' Association which had been founded in 1901, the Electrical Contractors' Association claims to be the oldest trade organisation within the British electrical industry. Mr. W. R. Rawlings, A.M.I.E.E., was its first president and held office again in 1914 and 1931. In the first issue of its official journal, *Electrical Contractor*, in 1903 the E.C.A. revealed its sole purpose as that of raising the technical and commercial status of installation engineers, protecting the trade against all types of unfair and dishonest competition and promoting the friendly unity of all sections of the

industry in the common cause of sound electrical development and effective public service.

In pursuit of this aim the E.C.A. gave active support to the establishment of E.D.A.; produced the first Electrical Fair Trading Policy in 1922; and helped to set up the voluntary National Register of Electrical Installation Contractors with the I.E.E. in 1924, in an endeavour to obtain compulsory registration. To encourage indentured apprenticeship, annual awards of medals, monetary grants and diplomas were instituted for successful apprentices in the City and Guilds examinations. N.E.C.T.A., Ltd., and the National Federated Electrical Association were promoted in 1916 as allied bodies to carry on the work of trading and Labour relations which were outside the scope of an incorporated body. The E.C.A. and allied associations now have a membership of some 3,000, attached to 82 branches in England, Wales and Ireland. The present president is Mr. R. A. Marryat, B.Sc.(Eng.), M.I.E.E., and the director and secretary is Mr. L. C. Penwill, C.B.E., Companion I.E.E.

Mr. R. A. Marryat

Mr. L. C. Penwill

Electrical Contractors' Association of Scotland

This Association was originally founded in Glasgow in 1900 under the chairmanship of Mr. Thomas Wright, of Anderson & Munro, Glasgow, who later became the third president of the Electrical Contractors' Association, Incorporated. As with the latter, the founders had realised the necessity for an organisation to settle uniform rules to regulate relations between employers and employees and also with corporations, manufacturers and architects, and when the E.C.A. was incorporated in 1904 the Scottish body agreed to amalgamate with it as one association for the whole country with a Scottish Section operating in Glasgow and Edinburgh. Activities were later extended to Dundee and Aberdeen.

Mr. D. G. Lindsay

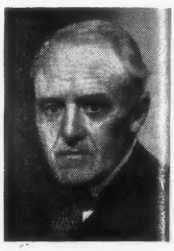
Mr. J. Smellie

In 1911, however, the Scottish Section decided to recast the Scottish membership into a separate entity and the E.C.A. of Scotland was re-formed. The Association was prominent in the establishment of a Scottish Mode of Measurement in 1915 and its Fair Trading Agreement of 1925 had its influence on the eventual emergence of the Fair Trading Council and Policy. Mr. D. G. Lindsay, A.M.I.E.E., will be president at the time of the Convention; the secretary is Mr. J. Smellie.

Electrical Wholesalers' Federation

Since its creation in 1914, the Electrical Wholesalers' Federation has aimed to maintain the fundamental principle that its members must be accredited electrical wholesale distributors, with suitable premises, equipment and organisation, carrying adequate stocks and therefore in a position to render a proper, efficient service to the contracting and retailing side of the electrical industry, and to secure proper and equitable trading conditions for all electrical wholesalers, whether members or non-members. Among the founder members were R. W. Smith (Drake & Gorham Wholesale, Ltd.), the first chairman of the Federation; A. G. Beaver (Sun Electrical Co., Ltd.), three times president; George and Walter Donovan (Donovan Electrical Co., Ltd.), both later presidents; and P. L. Davies (Downes & Davies, Ltd.). They decided to give home manufactures (as against imported goods) their exclusive support and encourage commercial unity between the manufacturers and wholesalers.

Mr. T. D. Woods



Mr. A. B. Wildsmith

At the end of the first world war, with an influx of new members their aims were more effectively put into practice. Investigation was made of every firm claiming wholesale status and research into the problem of electrical distribution and the work of organising it was begun. A permanent contact was made between the Federation and most of the electrical manufacturers' associations, and through this medium trading codes, status discount margins, marketing methods, trade abuses, etc., all came under consideration, though members were not restricted to the terms arranged. Its work was furthered in 1933, when it became established as a trade union instead of a limited company. This year's president of the E.W.F. is Mr. T. D. Woods and the director is Mr. A. B. Wildsmith.

Institution of Electrical Engineers

Founded in 1871 as the Society of Telegraph Engineers, this body became the Society of Telegraph Engineers and Electricians in 1880 and adopted its present style in 1888. It was granted a Royal Charter in 1921 and has at present more than 40,000 members. The main purpose of the Institution is to promote the general advancement of electrical science and engineering and their applications. It does this by the interchange of information and ideas through papers and printed proceedings, by the organisation of conferences, by encouraging education, by acting as a qualifying and regulating body and in many other ways.

There are four specialised Sections—Measurement and Control, Radio and Telecommunication, Supply, and Utilisation, ten main provincial Centres and eleven Sub-Centres as well as branches and committees overseas. The Institution offers a number of awards for papers and there are twenty scholarships of various kinds within its gift.

Regulations for the Electrical Equipment of Buildings, for the Electrical Equipment of Ships and for the Electrical Equipment of Aircraft have been formulated by the Institution and are kept under constant review; Model Forms of General conditions of Contract have also been produced. The I.E.E. has many committees and nominates representatives to a number of national and international movements for the advancement of electrical science and engineering and their applications.

Mr. W. K. Brasher

Sir George Nelson

Its presidents have included many leading electrical scientists and engineers of the past eighty years or more. This year's president is Sir George Nelson, Bt., F.C.G.I., M.I.Mech.E., M.I.E.E. The secretary of the Institution is Mr. W. K. Brasher, C.B.E., M.A.

North of Scotland Hydro-Electric Board

As the result of the report of the Cooper Committee on Hydro-Electric Development in Scotland Parliament passed, in 1943, the Hydro-Electric Development (Scotland) Act. This set up the North of Scotland Hydro-Electric Board to develop the water power of the Highlands largely with a view to the "rehabilitation" of that area.

Mr. T. Johnston

By the end of last year the Board's hydro-electric stations (25 plus "small compensation water stations, etc.") had a capacity of 558,795 kW and during 1955 generated about 840 million kWh; there were also two steam stations (Aberdeen and Dundee) which produced 528 million kWh as well as 23 diesel stations with an output of some 64 million kWh; there were over 338,000 consumers.

The chairman of the Board is the Rt. Hon. Thomas Johnston, P.C., C.H., LL.D.

South of Scotland Electricity Board

Mr. J. S. Pickles

By the Electricity Reorganisation (Scotland) Act of 1954 the South West and South East Scotland Electricity Boards and the corresponding generating Divisions were separated from the British Electricity Authority as from 1st April, 1955, and placed under the jurisdiction of a new South of Scotland Electricity Board. An important outcome of this was the recombination of generation and distribution.

The Board (whose chairman is Mr. J. S. Pickles, former chairman of the S.W. Scotland Board) recently issued its first report (April-December, 1955). This showed a surplus of £588,824. Energy generated totalled 3,513 million kWh and 416 million kWh was purchased. The installed capacity of plant was 1,252 MW; there were 1,234,161 consumers.

Water-Tube Boilermakers' Association

The W.T.B.A. came into being in 1933. It exists to provide the members with a means of joint consultation on matters appertaining to the manufacture and supply of water-tube steam boiler plant. One of the Association's main functions is to initiate and finance research into all aspects of steam raising. The following companies are members of the Association:—Babcock & Wilcox, Ltd., Clarke, Chapman & Co., Ltd., International Combustion, Ltd., John Thompson Water-Tube Boilers, Ltd., Simon-Carves, Ltd., and Yarrow & Co., Ltd. The present chairman is Mr. R. B. Potter, chairman of Simon-Carves, Ltd., and the director is Mr. K. J. McKillop.

Mr. R. B. Potter

Mr. K. J. McKillop

The remaining organisations which sponsor the Convention are the Douglas Corporation Electricity Undertaking, the Electricity Undertakings in Northern Ireland, the Isle of Man Electricity Board, the Jersey Electricity Co., Ltd., the States of Guernsey Electricity Department, the National Register of Electrical Installation Contractors and the Staff Associations' Committee.

TO BE SEEN AT THE EXHIBITION

THIS year nearly ninety organisations are taking part in the exhibition arranged in conjunction with the British Electrical Power Convention at Torquay. This is being held in the Torre Abbey Meadows, Torbay Road, from 23rd to 29th May and is organised as usual by the British Electrical Development Association. In addition E.D.A. will have a three-bedroomed all-electric house adjoining the exhibition to demonstrate the wide range of domestic electrical appliances available for the modern home. Electric floor warming is installed and there is also a display of electric gardening tools.

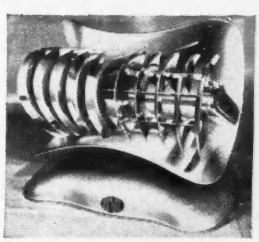
A special area has exhibits dealing specifically with electric road traction arranged by the Electric Vehicle Association.

The exhibition will be open to the public from Friday, 25th until Tuesday, 29th May and to delegates and ticket holders only on 23rd and 24th May.

Among the exhibitors of refrigerators is the General Electric Co., Ltd., who have introduced a butter compartment recess in the door of their de luxe 8 cu ft refrigerator. This refinement is provided at no additional cost. Also prominently displayed on this stand is a new popular priced "Quality" cooker shown in conjunction with G.E.C. wall-mounted auto-timers. Marco Refrigerators, Ltd., show large commercial refrigerators such as the "Victor," the "Carlton" and the "Astoria 25"; and frozen food display cabinets with glass risers and a non-refrigerated illuminated display feature stretching almost the whole width of the front panel of the main cabinet, for the display of dummy cartons. For dealing with the increasing demand for quick freezing food the 6ft "Woking" display counter has been produced.

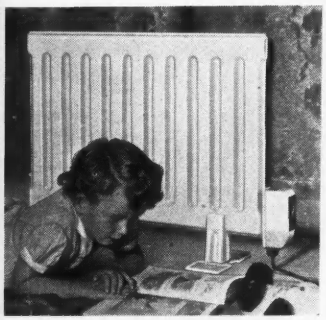
Astral refrigerators are prominently displayed on the stand of Morphy-Richards, Ltd., including the "Console" model which with a capacity of 2·3 cu ft and a shelf area of 5 sq ft is intended to provide refrigeration for the small family at a low price. A new product shown on this stand is an electric blanket available for single or double beds and for use on either a.c. or d.c. Frigidaire were the introducers in this country of brightly coloured refrigerators and in the 1956 range a completely new model is the de luxe DT-44. This offers more than 8 sq ft of shelf area in 4·4 cu ft of storage space and includes a large super freezer, a full width hydrator, a roomy butter compartment and an interior light.

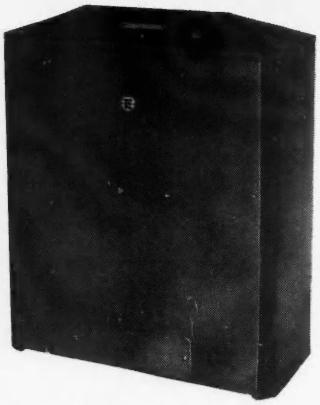
Electric heaters are prominently displayed on many stands including that of H.M.V. Household Appliances. The well-known "Cavendish" convection heater is now available in an entirely new range of two-colour schemes and the "Lincoln" which has a highly polished H.M.V. multi-parabolic reflector now has a range of three colours for the base. Berry's Electric, Ltd., show in their heating section their new illuminated radiators, a 3 kW development of the "Masterberry" fire, and a 2 kW low-priced "Magicoal" fire. Also new on this stand is a 3 gallon "Aquamatic" water heater which is available in four colours, and 25 new contemporary



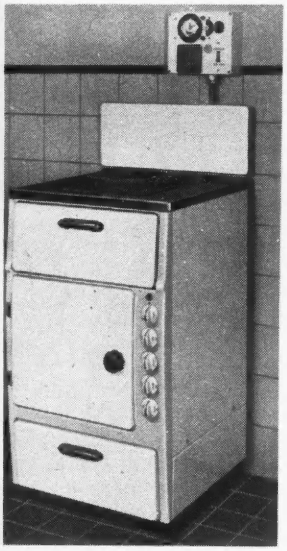
H.M.V. "Lincoln" fire

The butter compartment recessed in the door of the G.E.C. DE 81B 8 cu ft refrigerator keeps ½ lb in good condition for table use

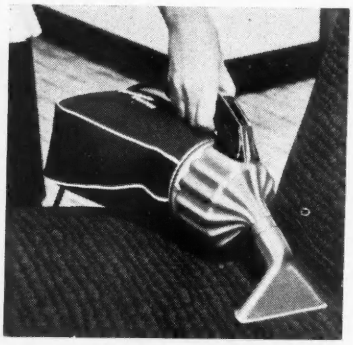




rseal oil-filled radiators are ideal for nursery use and (right) E. K. Cole " Thermostor " 1½ kW thermal storage heater

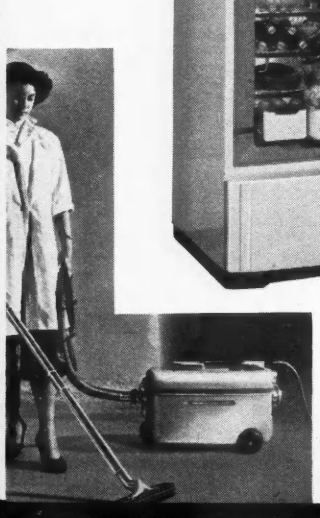


" Britannia " electric cooker with uto-timer unit, by British National Electrics, Ltd.



Vactric electric duster

1,050 W 6¼in dia. E.D.A. single circuit radiant boiling plate by the Backer Electric Co.



Electrolux L.730 refrigerator and (left) Model 33 light industrial vacuum cleaner

designs of lighting fittings shown among other better known types. In these, glassware and metal work are used with imagination to produce gay, brightly coloured fittings at surprisingly little cost.

Among the comprehensive range of heaters on the stand of Hurseal, Ltd., is a flameproof radiator with a specially designed head to conform to B.S. enabling it to be used in safety where other forms of heating might cause fire or explosion. This company's well-known oil-fired safety radiators are prominently shown as well as a re-designed streamlined plug-in thermostat modified so that it can now be fitted as easily as a normal household three-pin plug and can be used with any electric heater. Dimplex, Ltd., display three new products, a permanently oil-filled electric towel rail, a permanently oil-filled electric airing cupboard heater and an electric skirting-board heater. The first of these has a 250 W element and is so designed as to allow for wall or floor mounting. The airing cupboard heater has a 125 W element and the skirting heater is 3ft in length with a 500 W ceramic packed steel sheathed element: it is designed to provide convection and radiation on a broad front.

The " Cotswold " fan heaters are prominently shown on the stand of Gillott Electro Appliances, Ltd. The Thermovent heating division of E. K. Cole, Ltd., has entered the thermal storage heater market with the introduction of two models to be known as Ekco " Thermostors." These new heaters will be available for the coming heating season and have loadings of 1½ and 2¼ kW respectively. A charging time of 8-10 hours during the night provides continuous heating throughout the following day: an ingenious point of design is that the top of the case is sloping to restrict its indiscriminate use as a shelf and possible over-heating from this cause.

A range of skirting panels, low-temperature panels and an inset convector are recent introductions shown by Unity Heating, Ltd.

Among regular exhibitors at this convention are Electrolux, Ltd., who show their well-known domestic suction cleaners and the Model 33 light industrial cleaner. The comparatively recent turbo-polisher attachment introduced for use with the Model 55 suction cleaner is shown and the new full size floor polisher, the B9. Among the Electrolux refrigerators there are the L.230, L.500 and L.730 types, and prominence is given to the M151 built-in model intended for incorporation in a kitchen at the design stage. Vactric, Ltd., have introduced to their range of cleaning appliances a new upright electric cleaner, the R56, now on view for the first time. This is a lightweight model with a six-point positive adjustment to cover different thicknesses of carpet. It has a wide cleaning area and is constructed to reach fully to carpet edges: a light is incorporated and a number of attachments for cleaning curtains, upholstery, etc., are available.

Cookers are prominently displayed at this year's exhibition including a growing number which have automatic time controls. Among exhibits of this nature is the Creda " Carefree " of Simplex Electric Co., Ltd. This was launched at last year's B.E.P.C. and is now available in a range of four colours. With its 3,000 cu in oven, its warming drawer, which is time controlled as well, and its eye level controls, it has proved extremely popular. Creda water heaters exhibited include the " Crusader " three gallon flush-to-wall rapid recovery water heater and the " Dulec," a fully automatic water heater for providing large or small quantities of hot water as required by using two separate thermostatically controlled heating elements. A new Simplex lighting product shown on this stand is a corrosion resistant fluorescent fitting. This is a 5ft unit designed especially for chemical and similar industries.

The Jackson Electric Stove Co., Ltd., are showing principally their 390 range of cookers which were introduced earlier this year, together with the " Cookalone " auto-control splash panel, prototypes of which were shown at the Ideal Home Exhibition. These are now in current production and are displayed both on the 390 and the 190 series cookers.

Almost all the exhibits on the stand of the Revo Electric Co., Ltd., are new products, and the most striking of these is the new " Revomatic " cooker seen for the first time.

This attractive cooker incorporates automatic control timing for delayed action cooking in the oven and timed operations on the hob. Other additions are a floodlit hob and illuminated oven, an extra large grill boiler with a loading of 3,000 W, an appliance plug which can also be timer controlled and a built-in recipe chart which can be turned to reveal individual recipes behind a magnifying glass window. The cooker is finished in vitreous enamel and is offered with a range of coloured hobs. The total loading is 8·7 kW. Among other new items on this stand are two automatic kettles and the "Mayfair" plate warmer.

Another new cooker shown for the first time at the Exhibition and having a bow front design is the "Britannia" of British National Electrics, Ltd. This is available as a basic two-plate or three-plate model which can be fitted with a cold or heated drawer and can be arranged for automatic time control by the addition of the B.N.E. auto-timer control unit. A choice of two colour schemes is offered. B.N.E. also show their immersion heaters, recently reduced in price, as well as non-pressure water heaters and their convector heaters.

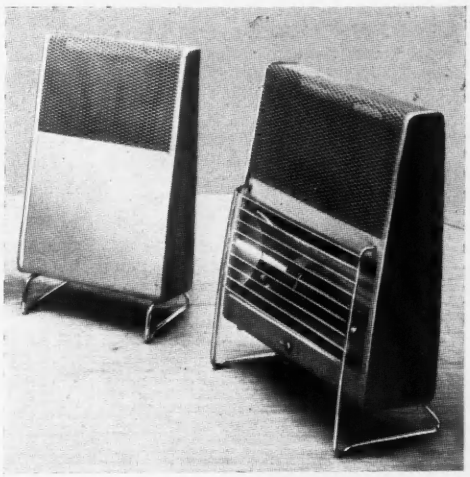
A grill boiler designed for use in rooms other than a kitchen has been introduced by Tricity Cookers, Ltd. Styled the Tricity "Trivet," it is available in a range of colours and is of attractive design. A hinged lid forms a useful splash back and the cooker is fitted with a standard E.D.A. grill boiler. The loading is 2·25 kW. The company also displays a range of full-size cookers including the "Coronet," introduced last year, and the "Queen" which is now available with fittings in grey, pale blue, dark blue, red, green and black in addition to maroon. All the cookers shown by Belling & Co., Ltd., including both the standard models and those fitted with auto-timers, are now available in eight different colour combinations. The company also exhibits drying cabinets and a new range of "Zephyr" convector heaters.

Several companies show goods related to cooking including Crown Merton who have two recently produced domestic utensils on view, one being an improved omelette pan and the other a long-handled colander. Both of these are internally treated with a special finish developed to prevent scratching and facilitate cleaning. A range of heavy duty utensils is also shown developed to withstand the high temperature ranges of super fast hot-plates now visualised by certain electric cooker manufacturers. Bulpitt & Sons, Ltd., well known for their "Swan Brand" goods, display a new electric whistling kettle which has a very high performance with its 2,000 W element. This has a 3 pint capacity. Immersion heater elements are also shown on this stand.

Among the exhibitors of water heaters are Santon, Ltd., who show for the first time in many colour variations a new two gallon contemporary design of thermal storage heater. A prototype of this unit was shown at the A.S.E.E. Exhibition. It has a loading of 1 kW and incorporates a fixed setting thermostat. The Backer Electric Co., Ltd., are showing typical examples from their wide range of single, double and triple circuit E.D.A. boiling plates for cookers, and American type plates with the broad, highly polished support ring embellishment. Heatrae, Ltd., show their "Lido" water heater as the main item against a background of 125 gallon pressure type water heaters. "Slimrod" immersion heaters are also shown.

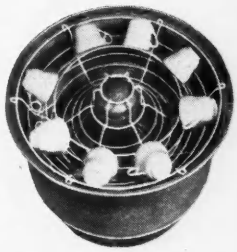
Three "Sunbeam" electrical appliances are at present available in this country and are shown on the stand of Sunbeam Electric, Ltd. These are the "Mixmaster" for food mixing, the "Shavemaster" which has a large smooth continuous-round shaving head with more than 3,000 shaving edges, and the Sunbeam automatic frypan. The "Chef" mixer made by the Kenwood Manufacturing Co., Ltd., is now available in a new colour range including red, yellow, green and blue.

Among the items shown by Parnall (Yate), Ltd., are their model EW 50 all-electric washer which can be supplied with a 3 kW heating element, the "Thor" combined clothes and dish washing machine and the Parnall "Ezy-press" ironer which is operated by a single control knob applying and releasing pressure. Another washday item is a small

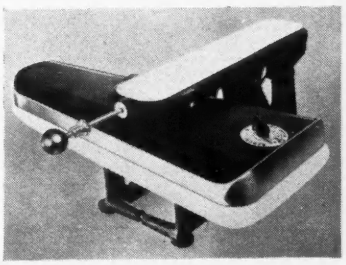


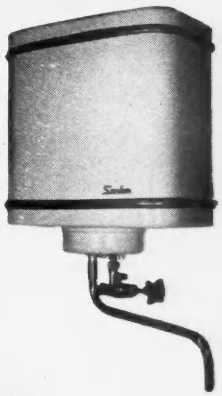
Two examples of the range of Revo heaters

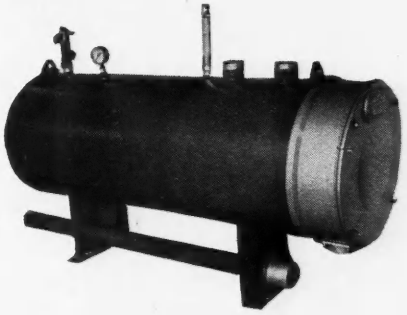
Right: The "Revomatic" cooker has attractive lines



Parnall/Thor products on view include the "Thor" combined clothes and dish washing machine, shown here loaded with crockery; and (below) the "Ezy-Press" ironer, operated by a single control knob







Santon heavy duty flow heater and (above) their new two gallon sink heater

spin dryer shown by Morphy-Richards, Ltd., which has a loading of only 350 W and is ideal for flat dwellers.

Chilton Electric Products, Ltd., also show a portable spin dryer, a newly introduced product claimed to be the cheapest on the market. Drying is by centrifugal force and it employs a $\frac{1}{10}$ h.p. motor. In addition, the company displays samples of its "Buk" and "Kub" dry shavers and a new model, the Chilton "Twin," a double head "de-luxe" shaver incorporating ten separate spring-loaded cutters and an on/off switch.

On the stand of Hoover, Ltd., is the recently introduced model of their Mark III washing machine which incorporates an electric water heater. Also shown is the double stretch "Hooverflex" hose for use with the cleaning tools of two of the Hoover cleaners. This is of flexible plastic reinforced with plastic coated spring wire and it easily stretches to reach the furthest corner.

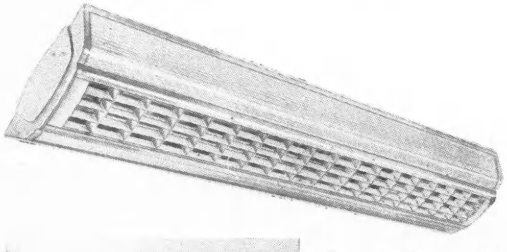
Burco, Ltd., place the main emphasis on the new 122 electric wash boiler and washing machine combined with an automatic pump and in addition to the normal design of this, there is a model in "Perspex" showing the working parts. Emphasis is also being given to another recent addition to their range, the "Baby Burco" five-gallon electric wash boiler which plugs in to an ordinary socket outlet and is less than 20in high. An interesting display on the Servis stand is a series of photographs devoted to the various washing machines which the company has made over the last 25 years. The most up-to-date machines are demonstrated, including two-tone coloured cabinet models available in red, green, blue or yellow, in combination with either white or cream.

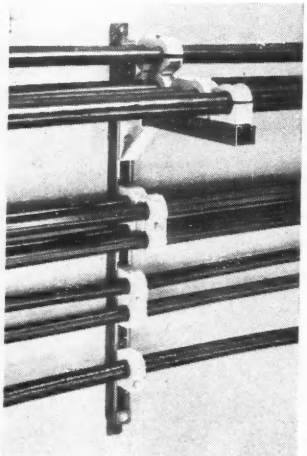
A range of home laundry equipment exhibited by Creston Electric, Ltd., includes the "Creston" washing machine which is now available with a 2 kW heater. The Hotpoint Electric Appliance Co., Ltd., shows products marketed by the Coldrator and Premier Electric Heaters Divisions. The Hotpoint section concentrates on a display of washing machines, table and rotary ironers, a clothes dryer and the "Rightweight" and "Plus Five" irons. Coldrator products include the CT.33 and CT.45 table top refrigerators and a new 8 cu ft model, the CS.81, together with a home freezer and a service cabinet. Electric fires, blankets, kettles, irons and sterilisers are among the Premier products.

A number of companies are showing lighting equipment both for the home and for public purposes. The Homeshade Co., Ltd., have a striking five-light pendant in solid brass with perforated leaf decorations in black, and grey lampholders, and an attractive three-light contemporary fitting in brass with cone-shaped shades and striped decorations. This company is exhibiting part of its new European collection comprising contemporary fittings from Denmark, Germany and Austria, and traditional fittings in metal and ceramics from Spain. Ekco lighting equipment on view features prominently the new soft-light tungsten lamp with pink toning. A number of industrial and decorative fluorescent fittings are also shown.

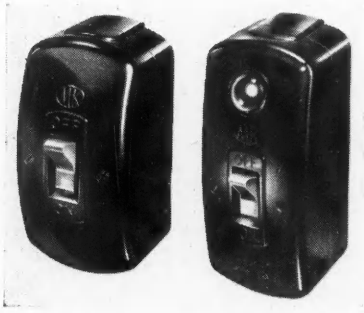
A full range of matched electrical accessories is shown by New Day Electrical Accessories, Ltd. Made from moulded materials, there are various types of domestic wall switches, single and multiple socket outlets, pilot control switches and multi-switch assemblies. A twin switch unit providing two 5 A flush switches in a single-gang size plate to fit the existing one-gang box is shown by the Edison Swan Electric Co., Ltd., together with a metal-clad switch with an aluminium finished pressed steel box, 5 A and 15 A pressed steel metal-clad surface switch socket outlets with protected nylon dollies for strength and durability, and an all-moulded ceiling switch with a nylon connector in place of the normal length of chain for extra strength and double insulation. The company is also showing a comprehensive range of cables, emergency lighting equipment and batteries.

The exhibits of Siemens Electric Lamps & Supplies, Ltd., include power and rubber covered cables, fluorescent lighting fittings, street lighting equipment and switch and fuse gear. There is also "Sierack," for speedily erected cable-carrying facilities on site by means of novel steel channelling and spring-loaded members. Two new introductions appear on the stand of M.K. Electric, Ltd. The first is a new range of cooker control units of attractive modern style and a range of double pole switches for water heaters and similar appliances. Other exhibits include the recently introduced "Gridswitch" range which has been augmented by an intermediate switch and a bell push, both of which are interchangeable with the one-way and two-way switches. Sunvic Controls, Ltd., are showing their Type TQB water heater thermostat and the Type TA.1 thermostat which is designed primarily for the control of convector heaters. It is a robust unit with a rapid response to tem-

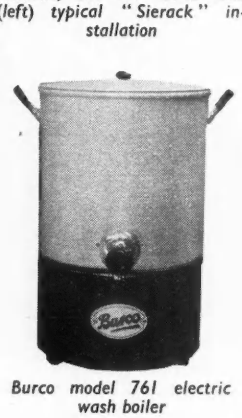




A new lighting fitting from Siemens, the FTF 5742 and (left) typical "Sierack" installation



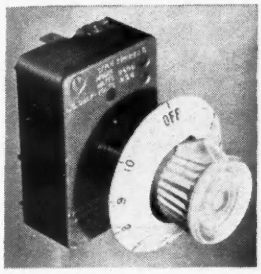
M.K. double-pole water heater control switches

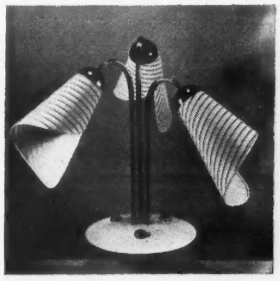


Burco model 761 electric wash boiler

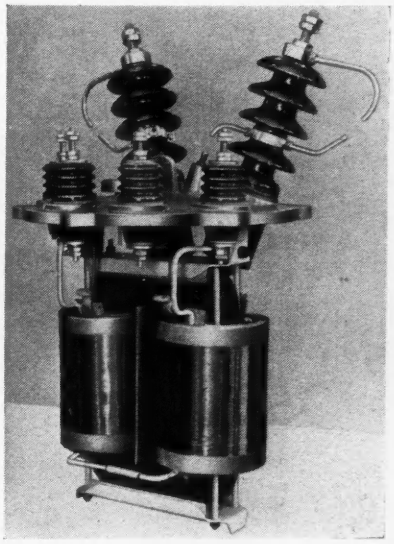
Partridge, Wilson l.v. transformers for feeding portable tools

"Satchwell" electric cooker thermostat and (below) "Satchwell" boiling plate control





Three-light contemporary fitting in brass by the Homeshade Co., Ltd.



Right: J. & P. wound core, single-phase 11 kV/250 V 10 kVA pole mounting transformer

perature changes and has a useful life in excess of 200,000 operations.

The new range of "Satchwell" electric boiling plate controls shown by the Rheostatic Co., Ltd., represents a big step forward in the operation of hot plates and provides electric cooker manufacturers with an opportunity of beating gas cooker competition. The controls are simple and enable consistent performance to be achieved at comparatively low cost. One device ensures a means of rapid boiling. Another exhibit is the new Type TC cooker thermostat which is of simpler construction than its predecessors but embodies the same quality and control virtues at a reduced cost. Among the new items shown by Robert Maclaren & Co., Ltd., is the Type MB water heating thermostat and a thermo-time regulator. The latter instrument links a thermostatically sensitive element and a clock to give a temperature-time programme. It can be used to save fuel with standard heating installations, switching on and off times of the system being varied in accordance with the outdoor temperature. It is also suited to the requirements of off-peak heating and process control generally.

The new "M" series snap-action 15 A 250 V a.c. thermostats shown by "Diamond H" Switches, Ltd., are specially designed for domestic and industrial appliances. These are of the proportioning type and incorporate highly sensitive snap-action micro-switching.

On the stand of Henry Wiggin & Co., Ltd., is a range of products indicating a wide use of nickel and its alloys in the generation of electric power and in the general field of electrical engineering. Exhibits of particular interest are a model of a Ruston & Hornsby "TA" gas turbine generator and an actual Rover-Rotax IS/60 portable gas turbine generator which has an output of 40 kVA. Hall & Pickles are exhibiting "Nicralloy" and "Kanthal" alloys, tapes and wires, capable of operating at temperatures up to 1,150 deg C and 1,350 deg C respectively. Among additions are "Kanthal" pyrometer sheaths for temperatures up to 1,400 deg C, "Nikrothal" industrial tubes and radiant plate tubes, and "Kanthal" and "Nicralloy" furnace elements.

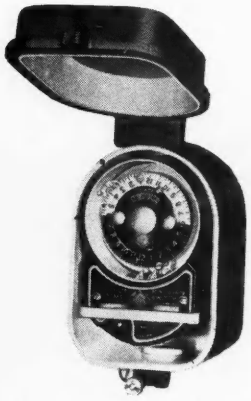
Significant contributions to assist in meeting the C.E.A.'s 9 per cent reduction in capital expenditure provide the highlights of the Johnson & Phillips stand, where frequent demonstrations of aluminium conductor jointing and a display of pole mounting transformers with wound cores of grain orientated steel can be seen. The latter type of transformer has a core wound from continuous strip grain-orientated cold-rolled steel and shows improvements in iron losses and no-load current. A considerable reduction in weight, 279 lb compared with the 450 lb of the conventional transformer, and its small dimensions, 31in by 17in, make it easy to handle. The equipment shown by the Hackbridge & Hewittic Electric Co., Ltd., comprises the standard glass bulb rectifier equipment as used for heavy duty d.c. supply, a model of a 120 MVA 275 kV auto-transformer, and a model showing part of a 1,000 kW combined air blast transformer and rectifier unit for heavy duty traction supply.

A display of overhead equipment for high voltage a.c. traction is shown by British Insulated Callender's Cables, Ltd. The equipment on view is typical of that installed on the Lancaster-Morecambe-Heysham route where British Railways gave British manufacturers an opportunity to demonstrate 6·6 kV 50 c/s equipment. In this section there are also cables for railway signalling and telecommunications. Other exhibits include telephone distribution cables, mains cables with aluminium conductors and copper sheathed mineral insulated cables. The Telegraph Construction & Maintenance Co., Ltd., is showing paper insulated cables with aluminium conductors and both lead or aluminium sheaths, and high voltage polythene insulated power cables for use underground or overhead. The Telcon range of armoured thermoplastic cables is also being displayed together with the appropriate glands.

The exhibits of Crompton Parkinson, Ltd., include representative examples of the latest traction and motor generator equipment and the display also includes an interesting selection of lamps, batteries and cables as used by transport undertakings.

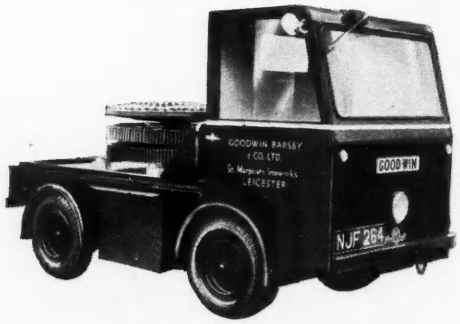
On the stand of the Metropolitan-Vickers Electrical Co., Ltd., are scale models of the company's BoBo and CoCo electric locomotives operating on the Manchester-Sheffield line. There is also a display of "Redring" boiling plates for electric cookers, including 6¼in and 8in diameter plates of the single element type for "Simmerstat" control and the double element for three-heat control. Also shown is the "Redring" boiler-griller which is designed to give high performance in both boiling and grilling. The makers claim that its boiling efficiency is roughly double that of the usual dual-purpose device and that grilling is not affected by boiling operations.

Cables for railway electrification shown by W. T. Henley's Telegraph Works Co., Ltd., include samples of a single-core aluminium sheathed oil-filled cable for operating at 25 kV a.c. to earth, together with suitable sealing ends. Apart from a wide range of other general and special purpose cables there is a new iron-clad service fuse for street lighting columns and a 60 A insulated double pole service fuse for mounting immediately below the house service meter. Wandleside Cable Works, Ltd., are showing a comprehensive selection of cables including thermoplastic, v.r.i., polythene, p.b.j., h.s.o.s. trailing and welding, farm wiring, "Wand-overplas" and "Corrusteel" armouring with copper and aluminium conductors. Perhaps the most important exhibit



Horstmann Type " Y " electrically wound time switch

Left : Reyrolle Type JKSS ring main oil switch and tee-off oil immersed fuse switch



Morrison industrial battery-electric road vehicle

is of irradiated plastics cables. The exhibits of Standard Telephones & Cables, Ltd., include high voltage capacitors, silicones, rectifiers for rail traction power conversion purposes, a new range of industrial type selenium rectifiers, alarm annunciation equipment, and a maximum amplitude measuring set. In addition to a scale model silicone rectifier conversion equipment for traction use, a silicone rectifier unit coupled to an oscilloscope is shown to demonstrate the outstanding electrical characteristics of this type of conversion.

Apart from a wide range of domestic appliances Ferranti, Ltd., have a pictorial display together with scale models of various types of large power, medium and distribution transformers, including a model of a 120 MVA, 275 kV transformer, several of which are being supplied to the C.E.A. for the supergrid. In addition, there is the Type W 7 range clip-on wattmeter. This is an entirely new instrument for the measurement of electrical power in a.c. circuits. The movement is of the iron cored dynamometer type and the ranges covered are from 0-3 to 0-300 kW at voltages up to 600 V and all are self-contained and conveniently selected by means of a thumb operated switch. The exhibits of Salford Electrical Instruments, Ltd., include a new range of 4in electrical indicating instruments with a special " platform " type scale which has been developed for electricity supply authorities. This type of scale reduces parallax and provides clearer indication of the quantity being covered. Selenium rectifiers are also shown incorporating a recent development in manufacture, by which the selenium layer is vacuum deposited. A lower forward resistance is achieved permitting increase in current rating of about 20 per cent. The new rectifiers will also operate at higher temperatures than hitherto.

The display of the Central Electricity Authority will illustrate the applications of electricity in vehicular traction. The theme is presented by means of photographs, diagrams, descriptive matter and models. In addition, information is given on the plans for the generation of electricity from nuclear energy and there is an inquiry bureau at which publications and general data concerning the operation and organisation of the electricity supply industry are available. The Electrical Industries Benevolent Association also has a stand which constitutes an information bureau with regard to the work of the Association for those non-manually engaged in all the electrical industries.

The exhibits which have been arranged by the South Western Electricity Board are confined to domestic items. The simplicity and cheapness of electric water heating is exemplified for a variety of sink and immersion heaters. In the home laundry section, demonstrations are given on several types of washing machines, dryers and ironers. There is a large selection of electric cookers and other sections are devoted to cleaners, space heaters, refrigerators, lighting and small appliances. To attract the public the Board is promoting a competition in the period of the exhibition. The display of time switches arranged by the Horstmann Gear Co., Ltd., includes models ranging from the small synchronous motor driven Type K to their heavy duty Type EH with a capacity at 250 V of 50 A a.c. or 25 A d.c. Smith Meters, Ltd., have a selection of power meters such as the " Sincos " kVA meter, polyphase meters with and without maximum demand indicators in both three- and four-wire designs, and a variable tariff prepayment meter. Sangamo Weston, Ltd., are showing examples of the Model S29 range of watthour meters both single and polyphase types, the latter with and without maximum demand indicators; nine models from the range of synchronous time switches; and a representative selection of Weston instruments with particular emphasis on models used by the electricity supply industry.

A representative selection of their new Class J range of rural switchgear units, including both extensible and non-extensible oil switches and oil-immersed fuse switches for 11 kV service is shown by A. Reyrolle & Co., Ltd. All of the oil switches are capable of breaking their rated load current of 400 A and of making on to a fault current equivalent to 250 MVA at 11 kV. The extensible units have cast resin insulated busbars of 400 A capacity and provision is made for earthing and pressure testing of all the cable circuits including those of the tee-off fused circuits.

Ottermill Switchgear, Ltd., are showing an industrial switchboard consisting of an incoming oil circuit-breaker unit and fused switch distribution section connected to form a composite floor mounting unit. The fused switches have q.m.q.b. parallel motion, and are of the range type-tested to 35 MVA making capacity and conforming to B.S. 2510 and B.S. 861, while the oil circuit-breaker complies with B.S. 936 : 1946. There is also a display unit showing 250 A overhead busbar trunking, 100 A miniature busbar trunking and cable trunking with various accessories such as tapping boxes, incoming cable units, tees, bends, etc.

The stand of South Wales Switchgear, Ltd., accommodates air insulated 11 kV switchgear for service up to 250 MVA, with sectioned D4 breaker, fault making 250 MVA isolator, Type I.F.4, and also C4X breaker with porcelain bushings, a control board with instruments and relays for the remote control of high voltage switchgear, and low voltage switch-fusegear for 400-440 V service up to 800 A, with flush mounting instruments, and built-in distribution boards. The Martindale Electric Co., Ltd., is exhibiting its range of blowers, etchers, sprayers, growlers, undercutters, and " Prufrex " A6 stator and rotor tester.

Equipment for use in the erection of overhead power transmission lines forms the bulk of the exhibits on Tate Bros.' stand. They show lightweight hydraulic compressors and dies for jointing steel-cored aluminium conductors from 0·2 to 0·4 sq in copper equivalent, midspan joints, bi-metal connectors, sagging wheels, etc.

" Kathanode " traction cells, suitable for all types of battery operated vehicles, are exhibited by the D. P. Battery Co., Ltd., who have a representative selection from

the complete range. Cells for diesel engine starting are also on view. Partridge, Wilson & Co., Ltd., have developed special low voltage transformers for use with low voltage hand tools and these can be seen on their stand together with a.c./d.c. rectifying sets for change-over schemes, and distribution transformers.

In keeping with the traction theme of the convention there are a number of electric vehicle makers represented at the exhibition. Austin Crompton Electric Vehicles have a stand which shows Morrison Electricars. One of these is the D4, a 20 cwt chassis with a heavy duty flat deck, for inter-works transport. Smiths Delivery Vehicles, Ltd., are exhibiting the "Commuter Minor," shown for the first time in this country and representing one of a range developed specially for the North American market. It is the only stand-sit local delivery vehicle made here.

LIST OF EXHIBITORS AND PLAN OF THE EXHIBITION

	Stand No.
AIDAS ELECTRIC, LTD., Sadia Works, Rowdell Road, Northolt	A.202
AUSTIN CROMPTON PARKINSON ELECTRIC VEHICLES, LTD., 95-99, Ladbroke Grove, London, W.11	A.102
BACKER ELECTRIC CO., LTD., Fitzwilliam Road, Rotherham	W.16
BAKER PLATINUM, LTD., 52, High Holborn, London, W.C.1	A.302
BELLING & CO., LTD., Bridge Works, Southbury Road, Enfield	A.211
BERRY'S ELECTRIC, LTD., Newman Street, London, W.1	A.512
BRITISH INSULATED CALLENDER'S CABLES, LTD., Prescot, Lancs	A.506
BRITISH NATIONAL ELECTRICS, LTD., Charlton, London, S.E.7	A.206
BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2	A.402
BRITISH VACUUM CLEANER & ENGINEERING CO., LTD., Leatherhead	A.311
BULPITT & SONS, LTD., Swansea Works, Birmingham, 1	A.209
BURCO, LTD., Rose Grove, Burnley	A.210
CABLE MAKERS' ASSOCIATION, High Holborn House, 52-54, High Holborn, London, W.C.1	A.508
CENTRAL ELECTRICITY AUTHORITY, Winsley Street, London, W.1	E.8
CHILTON ELECTRIC PRODUCTS, LTD., Hungerford, Berks	S.3
CHLORIDE BATTERIES, LTD., Clifton Junction, Swinton, Manchester	A.103
COLE, E. K., LTD., Ekco Works, Southend-on-Sea	N.7
CORFIELD-SIGG, LTD., Trafalgar Works, Merton Abbey, London, S.W.19	W.2
CRESTON ELECTRIC, LTD., Pennant Street, Oldham, Lancs	E.2
CROMPTON PARKINSON, LTD., Guiseley, nr. Leeds	A.101
"DIAMOND H" SWITCHES, LTD., Gunnersbury Avenue, London, W.4	A.303
DIMPLEX, LTD., Millbrook, Southampton	E.3
D.P. BATTERY CO., LTD., Bakewell	A.106
EDISON SWAN ELECTRIC CO., LTD., 155, Charing Cross Road, London, W.C.2	A.308
EKCO-ENSIGN ELECTRIC, LTD., Preston House, Essex Street, London, W.C.2	N.6
ELECTRIC LAMP MANUFACTURERS' ASSOCIATION, Lighting Service Bureau, 2, Savoy Hill, London, W.C.2	A.507
ELECTRICAL ASSOCIATION FOR WOMEN, 25, Foubert's Place, London, W.1	E.7
ELECTRICAL CONTRACTORS' ASSOCIATION, 14, Bedford Row, W.C.1	E.9
ELECTRICAL INDUSTRIES BENEVOLENT ASSOCIATION, 10 Buckingham Palace Gardens, London, S.W.1	W.9
ELECTRICAL JOURNAL, Bouverie House, 154, Fleet Street, London, E.C.4	W.12
ELECTROLUX, LTD., 153-155, Regent Street, London, W.1	A.407
E.M.I. SALES & SERVICE, LTD., Hayes, Middlesex	A.406
ENGLISH ELECTRIC CO., LTD., Queens House, Kingsway, London, W.C.2	A.405
FALK, STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.1	A.208
FERRANTI, LTD., Hollinwood, Lancs	A.304
FRIGIDAIRE DIVISION OF GENERAL MOTORS, LTD., Stag Lane, Kingsbury, London, N.W.9	A.205
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2	A.509
GILLOTT ELECTRO APPLIANCES, LTD., Cotswold Works, Chalford, Glos	E.5
HACKBRIDGE AND HEWITTIC ELECTRIC CO., LTD., Molesey Road, Hersham, Walton-on-Thames, Surrey	N.4
HALL & PICKLES, LTD., Manchester, 1	W.17
HEATRAE, LTD., Norwich	W.3
HELECS VEHICLES, LTD., 77, Baker Street, London, W.1	A.104
HENLEY'S, W. T., TELEGRAPH WORKS CO., LTD., 51/53, Hatton Garden, London, E.C.1	A.203
HOMESHADE CO., LTD., 99, Baker Street, London, W.1	W.6
HOOVER, LTD., Perivale, Greenford, Middlesex	A.306
HORSTMANN GEAR CO., LTD., Newbridge Works, Bath	W.4
HOTPOINT ELECTRIC APPLIANCE CO., LTD., Fletton, Peterborough	A.312
HURSEAL, LTD., 229, Regent Street, London, W.1	W.15
JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, London, S.W.1	A.309
JOHNSON & PHILLIPS, LTD., Charlton, London, S.E.7	A.207
KENWOOD MANUFACTURING CO., LTD., Hipley Street, Old Woking, Surrey	W.1
MACLAREN, ROBERT, & CO., LTD., 110, Kilbirnie Street, Glasgow, C.5	W.13
MACPHERSON, DONALD, & CO., LTD., 21, Albion Street, Manchester, 1	N.3
MARCO REFRIGERATORS, LTD., Manor Works, Streatham Vale, London, S.W.16	A.204
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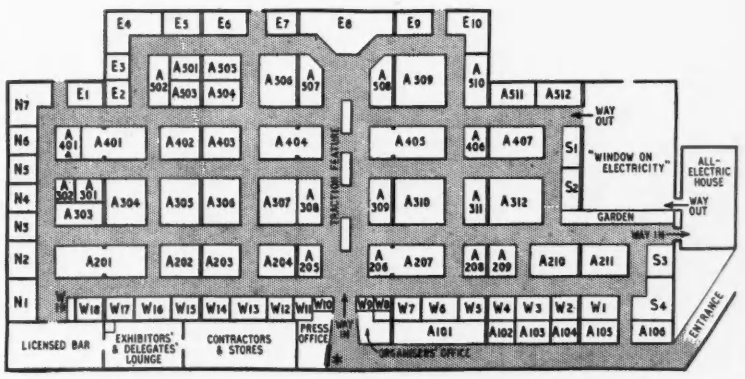


* *Electrical Review* illuminated guide to the stands.

Electric Railway Traction

A Brief Historical Survey

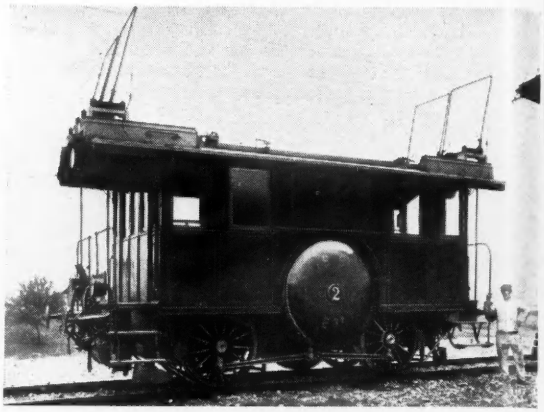
By B. K. COOPER*

ELECTRIC traction on railways has followed two principal lines of development. For over half a century the d.c. and the single-phase a.c. systems have flourished in different countries. Sometimes they have grown up side by side within the same frontiers, but in general the tendency has been for each country to have a bias towards one system or the other. A third system, three-phase traction, has remained strictly localised and for many years has been virtually static. To-day, the advent of single-phase traction at the industrial frequency of 50 c/s is seeing a new flexibility of approach in pooling the experience gained with all these forms of motive power.

The electric locomotive is a converter of energy, and its evolution has reflected the form in which the energy has been supplied. A very early experiment took place in Scotland in 1842, when Robert Davidson demonstrated a rudimentary battery locomotive in which the motor took the form of a drum carrying copper bars which were attracted by a series of electromagnets energised in sequence. Practical electric traction with power supplied from a central source can be dated from 1879, when a 3 h.p. locomotive designed by Werner von Siemens hauled trainloads of visitors on a track laid in the grounds of the Berlin Industrial Exhibition. This was the first application of the d.c. series motor to traction. Current was collected from a live rail and returned through the running rails, and the controller incorporated several accelerating notches, although these were obtained by a liquid rheostat instead of the usual metallic resistance grids.

With the ensuing development of d.c. generation, many short-distance urban electrifications took place in Europe and the U.S.A., but were operated mainly by tramway type vehicles. Volk's electric railway on the sea front at Brighton, opened on 3rd August, 1883, was the first public electric railway in Great Britain. The City and South London Railway, opened on 18th December, 1890, was the first underground electric railway in the world and the first standard gauge electrified line with locomotive haulage in Great Britain. The electric locomotives were each powered by two 50 h.p. motors with the armatures built directly on the axles. The field systems, supported at one side from the locomotive underframe and resting at the other side on the axle, foreshadowed the axle-hung, nose-suspended system which is still the normal method of motor suspension in British practice. Confidence in electric motive power was now reaching the point where its use could be considered on suitable sections of main lines.

In June, 1895, two short-distance suburban sections belonging to American main line railways were electrified



The first three-phase locomotive in the world, supplied by Brown-Boveri for the Burgdorf-Thun Railway in 1899

and operated by single-unit passenger cars and motor luggage vans. The first electrification of a main line proper was inaugurated on 1st August of the same year, when three 700 V electric locomotives built by the General Electric Company (U.S.A.) began service through the $1\frac{1}{2}$-mile tunnel in Baltimore of the Baltimore and Ohio Railroad. With their two motor bogies and central cabs, they set a pattern that was soon to become familiar, and is in fact still being used. The drive was gearless, but the armatures of the four 270 h.p. motors were mounted on hollow shafts embracing the axles and were coupled to the wheels by means of rubber blocks between the spokes. This form of flexible transmission was the precursor of many similar systems in the years to follow, particularly after the development of high-speed, bogie-mounted motors, although in its later variants the hollow shaft was driven through gears.

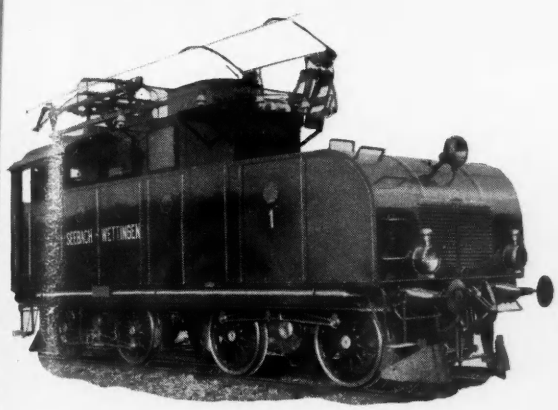
Early A.C. Systems

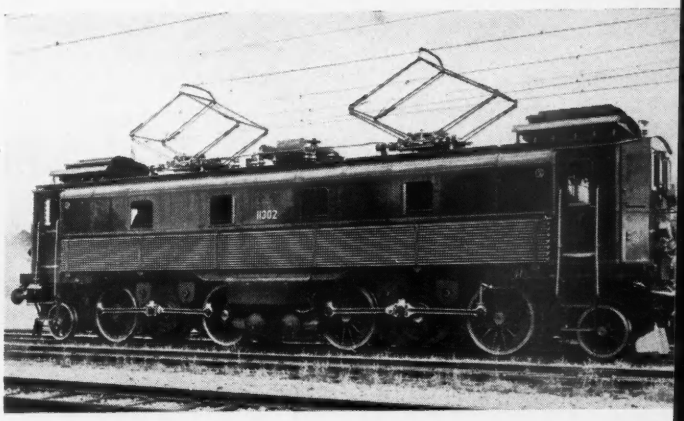
More extensive railway electrification now waited on the satisfactory long distance transmission of electric power. The history of electric traction has been complicated by the fact that when this came it was in the form of three-phase a.c., and therefore at the turn of the century considerable effort was devoted to the development of three-phase locomotives. The first a.c. railway electrification in the world, inaugurated between Burgdorf and Thun, Switzerland, on 21st July, 1899, was operated at first by two 150 h.p. 750 V locomotives in which the inconvenience of the single-speed induction motor was mitigated by using a two-speed mechanical gearbox. Power was transmitted to the two axles through a jackshaft and side rods.

Later three-phase locomotives have had up to four running speeds obtained electrically by combinations of pole-changing and cascade connection, but such arrangements do not provide the flexibility of control required for general railway service. A further disadvantage is the need for two overhead conductors (the rails being the neutral). Northern Italy at one time had a considerable three-phase main line mileage, partly to take advantage of automatic regenerative braking when descending gradients, but much of this has been converted to 3,000 V d.c. In Switzerland the Simplon Tunnel route, originally three-phase, was converted to single-phase in the 1930's.

Very early in its development the three-phase system captured a world rail speed record when two experimental motor coaches on the Marienfeld-Zossen line, near Berlin,

* The General Electric Co., Ltd.





Left: This Oerlikon design was the first single-phase a.c. locomotive in the world and operated originally on a 50 c/s supply. Right: Single-phase, 15 kV, 16⅔ c/s locomotive with four 600 h.p. traction motors and side-rod drive from two jackshafts, supplied by Brown-Boveri to the Swiss Federal Railways

both attained 130 m.p.h., which remained the highest authenticated speed on rails until 1931. During these trials the motor coaches were supplied with current at frequencies which could be varied in the generating station from 25 to 65 c/s, no electrical speed control being provided in the coaches, where the controllers served only to cut out the rotor resistances of the slip-ring motors during acceleration.

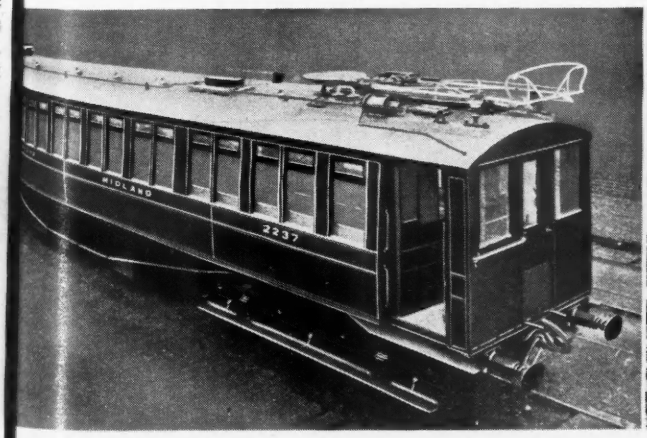
It is an interesting fact that although the Burgdorf-Thun line was supplied at 40 c/s (then a European industrial frequency), later three-phase electrifications were at 25 c/s, because this was convenient for the speeds desired on the steeply graded routes where they were installed. Had an industrial frequency been perpetuated, it is conceivable that the three-phase system would not have suffered its early eclipse, for the convenience of using an industrial supply, without the commutation difficulties soon to afflict the sponsors of single-phase a.c. traction, might have offset its other disadvantages.

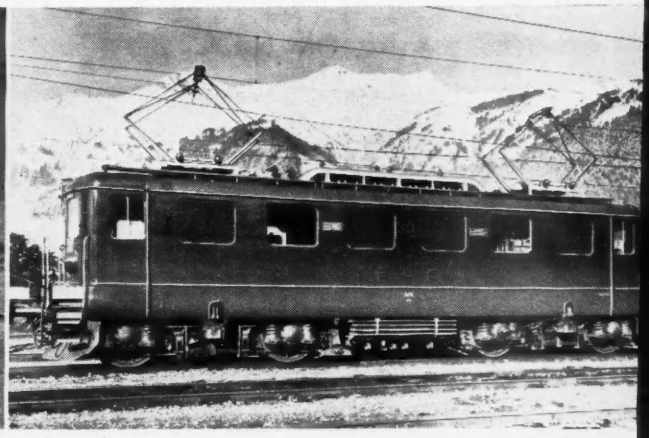
The desire to take advantage of high voltage a.c. distribution to the trains, while avoiding three-phase difficulties, led to the study of single-phase traction systems. In the first example of single-phase railway traction, on the Seebach-Wettingen line in Switzerland in 1904, the original locomotive was supplied from the contact wire at 15 kV, 50 c/s, and carried a motor-generator set to give a 600 V d.c. output for the two 200 h.p. traction motors. Attempts to dispense with conversion and operate series traction motors on a.c. encountered the difficulty of bad commutation caused by the transformer effect of the pulsating flux. As a result largely of the work of Behn-Eschenberg in Switzerland, the problem was overcome by adopting a low frequency (16⅔ c/s) in conjunction with resistive interpole shunts, the latter arranged to compensate for the effect fully at a speed in the normal operating range; resistance leads between the commutator and the armature windings were used to improve commutation at starting.

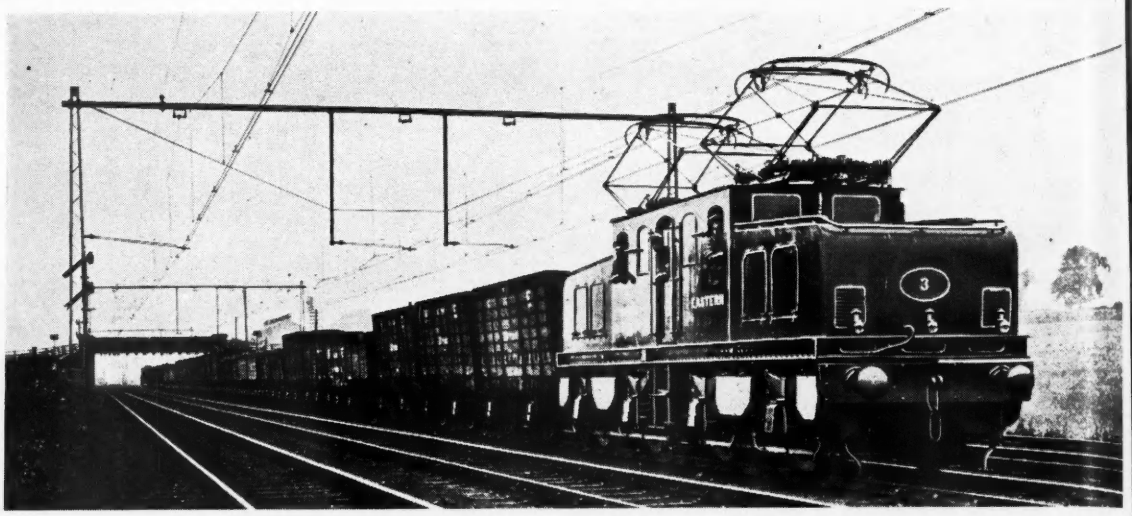
Single-phase railways in the United States operate at 25 c/s, which at the time the system was being developed was one of the industrial frequencies in use. The New York, New Haven and Hartford in 1907 completed the first important main-line single-phase electrification by converting its line from Woodlawn Junction to Stamford on the 11 kV, 25 c/s system.

The 16⅔ c/s frequency has been general for single-phase railways in Europe, being used in Austria, Germany, Norway, Sweden and Switzerland. It appeared first on a

Left: A.c. traction began in Britain on the Lancaster–Morecambe–Heysham line in 1908. The 6·6 kV, 25 c/s motor coach illustrated was equipped by Siemens Bros. Dynamo Works, Ltd., later acquired by the English Electric Co., Ltd., which in 1952 supplied the first British 50 c/s equipments for operation on the same line. Right: A 4,000 h.p. single-phase, 15 kV, 16⅔ c/s locomotive with Brown-Boveri electrical equipment and disc drive supplied to the Berne–Lotschberg–Simplon Railway in 1945







Freight train on the Newport–Shildon line, the first 1,500 V d.c. system in Britain, hauled by an electric locomotive equipped by Siemens Bros. Dynamo Works, Ltd., a constituent of the English Electric Co., Ltd.

European main line in 1910 when the Berne-Lotschberg-Simplon Railway began electrifying at 16⅔ c/s, on its main line from Berne to Brigue. In Britain the single-phase system was first used in 1908 on the Lancaster-Morecambe-Heysham line of the Midland Railway, with a 6·6 kV supply at 25 c/s. A year later the London, Brighton & South Coast Railway began its suburban electrification at the same voltage and frequency, with an eye to the eventual extension of its electrified system to the Sussex coast. When the railways were grouped in 1923, however, the decision was taken to convert the L.B.S.C.R. lines to 660 V d.c. to conform with the existing electrifications on the Western and Eastern sections of the Southern Railway.

The single-phase a.c. locomotive developed a characteristic form and appearance which for many years distinguished it clearly from d.c. machines and epitomised the differences of practice and opinion between a.c. and d.c. engineers. Because of the number of poles required, the traction motors were large, low-speed machines which were housed inside the locomotive body. There was no need to use four or six motors for the sake of speed control by different groupings as in d.c. practice, and so locomotives might be powered by two large motors driving the coupled axles through side rods, the drive being taken sometimes direct from the motor shaft, but more generally through gears and a jackshaft. Later, with the improvement of flexible transmission systems to allow for relative movement between the motors and the axles due to the springing of the locomotive, individual axle drives were installed from motors still mounted in the main frames.

By 1939 a.c. motors of 1,000 h.p. were being mounted in locomotive bogies, but it was not until 1945 that a powerful main-line design appeared in which non-motored guiding axles were dispensed with. This was a four-axle locomotive of 4,000 h.p. on the Berne-Lotschberg-Simplon Railway, and its general conception exercised immediate influence on main-line electric locomotive design both for a.c. and d.c. systems.

It is sometimes suggested to-day that the choice of a sub-standard frequency for a.c. traction was made overhastily and that it retarded the development of railway electrification with alternating current for some thirty years. It must be recalled, however, that when the decision was taken the widespread distribution of industrial frequency three-phase power had barely begun, and that the d.c. railways were also obliged to generate their own supplies at low frequency (usually 25 c/s) because efficient rotary convertors for 50 c/s had not then been designed.

Simultaneously with the early experiments with a.c. traction, progress was being made in the application of low-voltage d.c. electrification to short-distance routes. The multiple-unit control system, developed in the United States by Sprague and Thomson, made its first appearance in this country in 1903 on the Central London Railway. Trains on the Waterloo & City Railway, opened in 1898, already comprised two motor coaches with control from one driving cab, but all motors were controlled over power lines from one drum which handled the traction current. Also in 1903, low-voltage multiple-unit control was applied in some motor coaches of the Metropolitan District Railway, and in the new electric stock of the Mersey Railway, the electrification of which in that year was the first example in Great Britain of a steam-worked line being converted wholly to electric traction.

Main Line D.C. Electrification

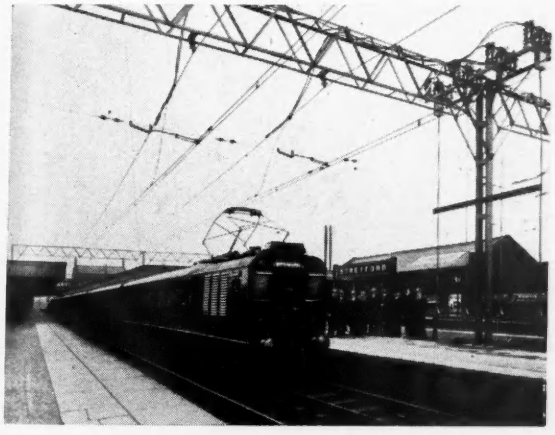
It was recognised from the outset that for heavy-duty, main-line work, d.c. voltages higher than those in use for short-distance underground and suburban lines would be desirable. Various projects in Europe and the U.S.A. preceded the 3,600 V experimental electrification of 1913 on the Lancashire & Yorkshire Railway between Bury and Holcombe Brook (3¾ miles), the first high-voltage d.c. scheme in the world. It was converted to a third-rail 1,200 V system in 1916 when electrification was extended from Bury to Manchester, because clearance difficulties imposed by overbridges on this section would have made the use of a 3,600 V overhead conductor impracticable.

At this time the 1,500 V d.c. overhead system made its first appearance in Great Britain, when the North Eastern Railway began electrifying its mineral line from Newport to Shildon (19 miles) in Co. Durham. The work was completed during the first world war and electrical operation of freight trains continued until declining traffic led to the installations being dismantled in 1931. But for the war, the North Eastern no doubt would have proceeded with its plans for 1,500 V d.c. electrification on the main line between York and Newcastle, for which an express electric locomotive was actually built, and ran trials on the Newport-Shildon section.

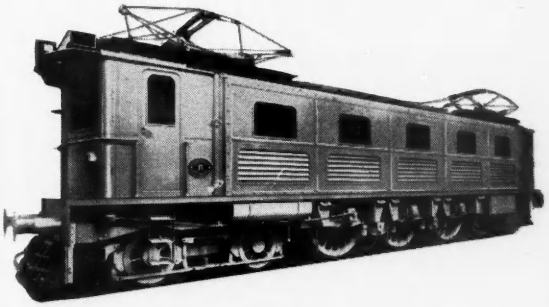
War in Europe arrested important developments for a number of years, and so it fell to the Chicago, Milwaukee, St. Paul & Pacific Railroad in the U.S.A. to inaugurate the first large-scale main-line electrification in the world at 3,000 V d.c., extending initially over the 437·4 miles of the Rocky Mountain section between Harlowtown and Avery.

In Great Britain in 1927 the Weir Committee reported in favour of 1,500 V d.c. for future main-line electrification, a conclusion largely confirmed as recently as 1950 by the Committee on Railway Electrification set up by the British Transport Commission. The first 1,500 V d.c. electrification in this country after the Weir Report was on the Manchester South Junction & Altrincham Railway in 1931, the first passenger-carrying line in this country operated on the 1,500 V d.c. overhead system. Both the Liverpool Street-Shenfield and the Manchester-Sheffield projects were planned in the inter-war years, but the second world war delayed their realisation. They were completed in 1949 and 1954 respectively. The Manchester-Sheffield electrification was the first main line in this country to handle all traffic with electric motive power.

The major British electrification development between the wars was the rapid growth of the Southern Railway 660 V d.c. electrification, which became the largest suburban electric railway system in the world and in 1933, with the London-Brighton-Worthing scheme, began the series of main-line extensions which to-day provide fast and frequent electric services between London, the Sussex coast and Portsmouth. These are operated by multiple-unit trains, but the Southern Region also has three mixed-traffic electric locomotives with a motor-generator control system. These began working the Newhaven boat train in 1948, providing the first example of a main-line passenger train in this country hauled by electric locomotives.



The first 1,500 V d.c. passenger trains in Britain were equipped by the G.E.C. and began running on the Manchester South Junction and Altrincham joint line in 1931



This 1,500 V d.c. locomotive supplied by the G.E.C. to the Great Indian Peninsula railway in 1927 is typical of the period in which a fixed driving wheelbase and guiding bogies were used

Electric Locomotive Design

After the early motor-bogie d.c. locomotives, there was a trend in some countries towards designs closer to steam locomotive practice, with a fixed driving wheelbase and guiding bogies. Side rod transmission was rare, individual axle drives being more convenient because of the possibility of using two or three motor groupings when a locomotive was powered by several motors. In a three-axle, fixed wheelbase design, twin-armature motors can be connected to give groupings of six armatures in series, two parallel groups of three armatures in series and three parallel groups of two armatures in series. Fixed-wheelbase d.c. locomotives continued to be built right up to the time of the recent Paris-Lyons electrification of the French National Railways, but the improved mechanical characteristics of powerful motor-bogie types since the second world war have annulled the advantages once claimed for the fixed wheelbase and guiding bogies in high-speed work.

For the fact that up to the present much of the world main-line electrified mileage has been d.c., the mercury-arc rectifier in its various forms is largely responsible. With the coming of the rectifier, private generation or frequency-conversion by the railways became unnecessary and substations could be connected direct to three-phase industrial networks. The steel tank water-cooled rectifier with vacuum pump, and the two pumpless forms, glass bulb and air-cooled steel tank, all had their first transport applications in the tramway or trolley-bus field before being used on railways. Water-cooled steel tank rectifiers were installed at five substations of the Midi Railway in France in 1923, and in Great Britain the first railway installation of this type was at the Trafford Park substation of the Manchester South Junction & Altrincham joint line in 1931. Pumpless, air-cooled steel tank rectifiers were first installed for traction at the Putney Bridge trolley-bus sub-

Goods train climbing a 1 in 50 gradient on the mountain section of the Chicago, Milwaukee, St. Paul & Pacific Railroad, the first 3,000 V d.c. main line electrification in the world

station of London Transport in 1936. Their first application to main-line railway work in Great Britain was at Purley substation, Southern Railway, in 1942.

In the first five years of the post-war period, d.c. traction was virtually unchallenged. In Europe, France, Belgium, Holland, Italy and Spain, all proceeded with major main-line conversion schemes, the Italian work including much conversion of former three-phase a.c. lines. New or extended main-line electrification with d.c. was undertaken in South Africa, New Zealand, Australia, India and Brazil. Extensions of single-phase, low-frequency traction were confined to countries where the system was already established, but included some major electrification programmes, such as those in Norway, Austria and Western Germany. Switzerland carried out various small schemes to complete its electrified network, which on the Swiss Federal Railways now amounts to 1,723 miles out of a total mileage of 1,802.

This was the situation in 1950, when the French National Railways inaugurated their 50 c/s electrification from Aix-les-Bains to Annecy and La Roche-sur-Foron. Previous experience with 50 c/s traction had been gained in Hungary, where the Kando single-phase/three-phase system was instituted in 1932 on the main line from Budapest to the frontier station at Hegyeshalom; and on the Hollental line in Germany, where a number of prototype locomotives were at work between 1937 and the outbreak of war. The Hollental line, in 1945, came into the French zone of occupation, and the experiments which had been suspended by the war were carried further by French engineers as a prelude to their own scheme in the Savoy.

The later Valenciennes-Thionville electrification of the French National Railways was completed and also extended to Lille in 1955. Work is in hand on extensions of this scheme to Strasbourg and Bale, and also on the electrification with 50 c/s, a.c. of the line from Dôle to the Swiss frontier at Vallorbe and Les Verrières, which connects with the 1,500 V d.c. Paris-Lyons main line and carries important international passenger trains originating in Paris and beyond. The connection is actually made at Dijon, but the Dijon-Dôle section is being electrified at 1,500 V d.c. to allow through running of the d.c. locomotives to Dôle, which is a more convenient point for changing engines. These projects, and the Paris-Strasbourg electrification now being studied, are a practical demonstration of the confidence of the French engineers in the 50 c/s system for every form of railway traffic.

The 50 c/s suburban electrification of the Turkish State Railways from Istanbul to Sirkeci is already in operation, and work is proceeding in Portugal on a main-line 50 c/s scheme from Lisbon to Oporto. In the Belgian Congo the line from Jadotville to Tenke, electrified at 50 c/s in 1951, was the first example of the adoption of locomotives with 50 c/s motors for normal commercial service as distinct from partly experimental purposes. A year later the time-expired 25 c/s equipment on the Lancaster-Morecambe-Heysham line in this country was removed and the line was electrified at 6,600 V, 50 c/s, to implement the proposal of the B.T.C. report that this form of traction should be put to practical test. The decision to adopt the 50 c/s, 25 kV system for all new electrification on British Railways except in the Southern Region, and to convert certain 1,500 V d.c. lines, was announced by the British Transport Commission on 6th March this year.

Oerlikon–S.L.M. locomotive with 50 c/s motors on the French National Railways line from Aix-les-Bains to La Roche-sur-Foron, where the first large-scale experiments with industrial frequency a.c. traction were carried out

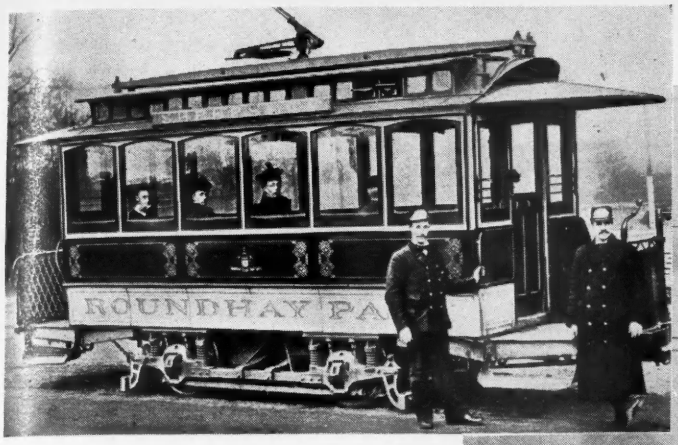
A historical review such as this is not the place in which to forecast future development, but it must be remarked that already, as a result of progress in industrial-frequency systems, there has been a revival of interest in railway electrification in the United States. It must also be recorded that the original prototype locomotives on the French National Railways did not include a rectifier design, and that the operation of a rectifier motor coach on the Pennsylvania Railroad in 1949 was the prelude to the keen interest now being shown in rectifier systems in all countries where 50 c/s traction is under consideration. Another U.S.A. development of considerable significance has been the construction for the New York, New Haven & Hartford Railroad of motor coaches and locomotives equipped for operation both from an overhead a.c. supply and a 660 V d.c. third rail. So far all these American motor coaches and locomotives are supplied on a.c. sections with single-phase current at 25 c/s, but the prospect of an eventual change-over to industrial frequency has influenced the selection of rectifier motive power.

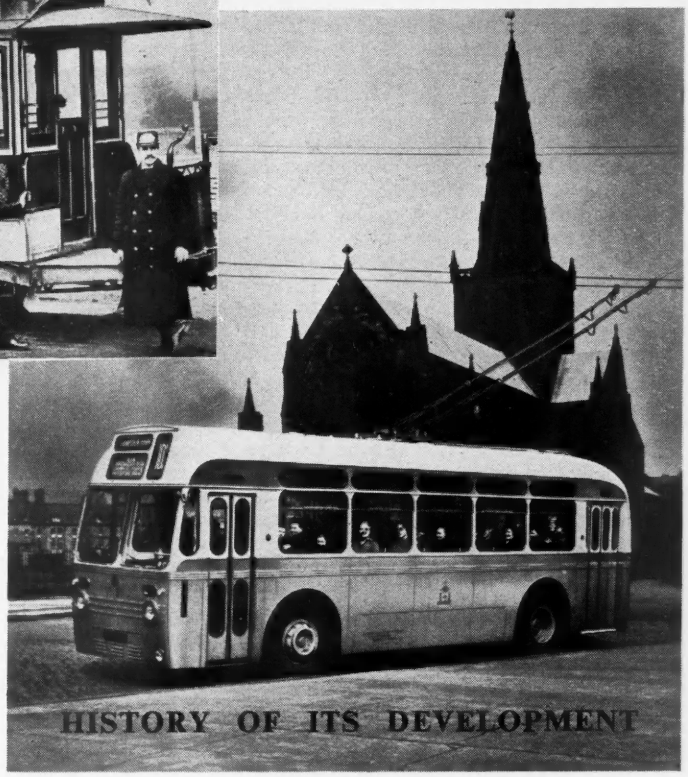
In the past, perhaps, the d.c. and the a.c. traction engineers have tended to pursue different paths. To-day, the paths converge, and both appreciate their indebtedness to industrial electrification and research as a whole. In considering the vast field of experience and achievement now at his service, the traction engineer to-day cannot fail to view with greater admiration than ever the accomplishments of the pioneers of fifty years ago in a territory largely unexplored.

Bimetallic Contacts

A BOOKLET, "Corrosion and its Prevention at Bimetallic Contacts," has been published by H.M. Stationery Office on behalf of the Corrosion and Electrodeposition Committee of the Inter-Service Metallurgical Research Council. It represents an attempt to provide up-to-date and reliable information on the subject, primarily for the benefit of designers in Government Departments and Government contractors, although it should be of considerable interest and value to all who are concerned with metallic corrosion.

General information is given on the conditions in which bimetallic contacts are most likely to lead to troublesome corrosion and the means of mitigating such effects. By a system of symbols a table indicates the relative effects on the corrosion of a range of metals when brought into mutual contact and bridged by water containing an electrolyte. The table is arranged in two main groups of metals, the first in sequence approximately similar to the "schedule of potentials" included in many documents. The second group comprises chromium, stainless steel, titanium and aluminium, which develop highly protective oxide films and behave as relatively noble metals under conditions favourable to the maintenance of such films but are in some cases less resistant in conditions in which breakdown of the films is possible. It is these metals in particular that cause difficulty in attempting to predict the behaviour of bimetallic contacts from a schedule of potentials.





By R. D. REYNOLDS,*
A.M.I.E.E., M.Inst.F.

Electric Road Traction

HISTORY OF ITS DEVELOPMENT

NOW that the importance of electric traction is being once more recognised by the electrical industry it is of interest to look back from those early years of the second half of this century to the second half of last century when electricity began to serve mankind in the field of transport. In the next century, when our successors have a longer period of electrical history to survey, the British Electrical Power Convention of 1956 will surely mark the renaissance of electric traction in all its forms in Britain.

Many of those who are now young in the industry will have little appreciation of the part that urban electric transport has played in the development of the electrical industry and in the industrial development of our country. My own experiences do not effectively extend beyond the early 1920's, which provide vivid recollections of the running up in the early hours of the morning of the first turbo-alternator set in the power station of a large industrial town, followed by the switching in and running up of rotary convertors to take the traction load as the first trams were ready for the road. In addition to being the first load on the station, traction was the last big load at night. During the few intervening night hours the station battery carried what little load there was.

The pattern of development in the pioneering days of public transport was very varied. In a great many cases the early institution of public transport systems was due to the enterprise of private individuals. Thus it was that Magnus Volk established a miniature railway along a section of the sea front at Brighton. This system and the Giant's Causeway and Portrush railways were opened in 1883 for public service. These small railed systems indicated the possibilities for electric traction. The Volk electric railway is really more a narrow gauge tramway on reserved track than a railway as we understand it. From such small beginnings electric tramways and electric railways evolved.

Before electric street traction developed, tramways were operated for a considerable period by horses. A practice in this country was for municipalities to construct railed track and lease the lines to private companies. When horses were gradually displaced the first mechanical units were operated by steam and to a small extent by compressed air, and by electric batteries. In several cases horses were still in use when some parts of a system were electrified. A London photograph taken in 1914 shows horse and electric cars in the same picture.

In a few instances cable car systems preceded electrification. There were, for example, two cable car systems in North London and a considerable system of the same kind operated in Edinburgh until 1922 when electric traction was adopted. The only cars now in the country operated by a moving cable system carry passengers up the Great Orme at Llandudno.

At the Royal Society of Arts in 1857 W. Bridges Adams presented a paper in which he advocated the laying down of rails in London streets for horse drawn vehicles, although one George Francis Train who established in 1861 a horse drawn railed system in Bayswater Road, which was the first to run in London, is generally given credit for conceiving the idea as well as putting it into effect. In the same year Train established a similar tramway in Birkenhead. In a short time this system was adopted by Liverpool, Glasgow, Leeds and Manchester.

In 1859, in another paper to the Society, Adams suggested the use of mechanical power which led the Society to offer a gold medal under the Howard Trust for a traction engine to pull street cars. One of the conditions of operation was that noise, noxious fumes, or the discharge

Above: One of the first cars taking current by the overhead system, Leeds, 1891, and (right) a modern single-deck Glasgow trolley-bus

*British Electrical Development Association.

of refuse into the air or on to the road surface should be avoided. Undoubtedly they had the right ideas at that date for it exactly meets to-day's needs. Although this specification was perfect for electricity it was a little too early for electric traction, for the prize was awarded to an engineer, John Grantham, who produced a steam tram in which the steam engine was actually incorporated in the passenger car. Most of the subsequent steam trams were hauled by small steam locomotives of box like appearance.

The year 1870 saw the Tramways Act which governed the setting up of tramway systems. In 1881 a Colonel Beaumont strongly advocated compressed air locomotives for trams and railways, supplies of compressed air to be picked up at intervals of approximately 10 miles. Compressed air driven trams are recorded as having had some success in Glasgow and North London.

Electricity Advocated

In the same year Alexander Siemens was advocating the use of electricity as the motive power for traction. In the eighties battery cars operated along the Barking Road, and Birmingham had three miles of double track, 3ft 6in gauge, operated by twelve battery electric cars each carrying 90 Epstein cells of 90 Ah capacity. Compared with much of the country, London lagged in the electrification of tramways, which did not commence in a big way until 1903. The first overhead wire tramway system was put into experimental operation in Leeds in 1891.

The early years of the present century witnessed a vast change from other forms of railed street traction to electricity, and some of the electric cars put into use were converted horse trams. Many of the towns which had no regular public transport service received this benefit for the first time in the form of electric tramways. What a boon to such places it must have been.

Urban Electric Traction

Electric street traction so revolutionised public transport that it was one of the potent factors in producing the great industrial expansion that took place in the early years of the century. The railways were of course well established but it was only with the arrival of electric road passenger transport that great masses of people were able to travel to and from work, or about their districts, cheaply and quickly by a frequent service of vehicles.

In addition to the development of the electric street tramway the late years of the last century and the early years of this saw the arrival of horseless carriages in the form of landaulettes and broughams, powered by electric batteries; they were mostly owned by people who could afford their own private carriages. In the first decade of the century quite a fleet of battery electric taxi-cabs were operated in London by the Electric Landaulette Co.

One of three early battery electric carriages of French make (a Krieger electric brougham built in Paris about 1900) is now owned by Chloride Batteries, Ltd. This vehicle is driven by two motors each driving through a simple pinion and fixed wheel with helical teeth on the front wheels. A traction battery of 193 Ah capacity provides the power. The range is approximately 45 miles per charge. The maximum speed is 18-20 m.p.h. It is essentially a town carriage and despite its weight of two tons it is extremely easy to handle in traffic and its acceleration is frequently better than i.c. engined cars 50 years its junior. The original upholstery and paintwork are still good for many years.

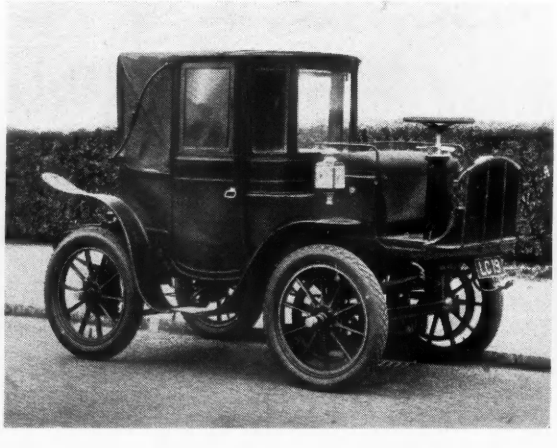
Apart from passenger work in its early years, subsequent development in the use of the battery electric vehicle has been almost wholly in the commercial and industrial spheres although Germany is making good use of battery electric passenger rail cars on the Federal Railways.

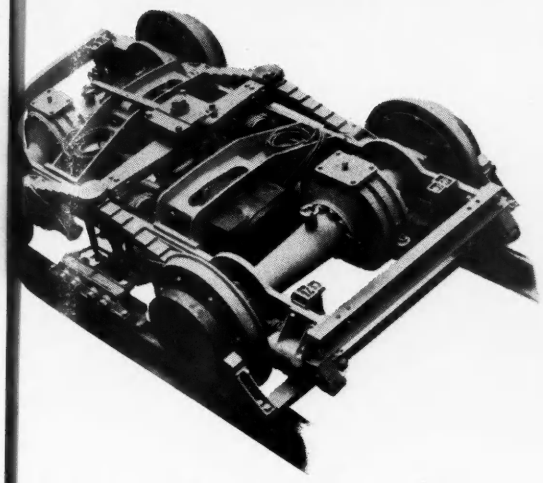
The many examples of the use of electricity are so bound up with modern living that it is difficult to realise that it is only about 70 years since electric power was beginning to be understood. Its early application to street traction undoubtedly aided in a big way the building up of our great electrical manufacturing industry for it produced a big demand for power station generating plant, converting plant, motors and control gear, for vehicles, cables, overhead equipment, etc. The big home development of electric traction that took place also put our manufacturers in a good position for securing business in the electric transport field abroad and many overseas systems were established with British equipment; indeed some were established as British run concerns (for example, the Calcutta and Lisbon Tramways, both still British owned).

The development of urban electric transport also greatly helped the early development of public electricity supply; it may be said to have brought forward the electrical age. Many general electricity supply stations developed from

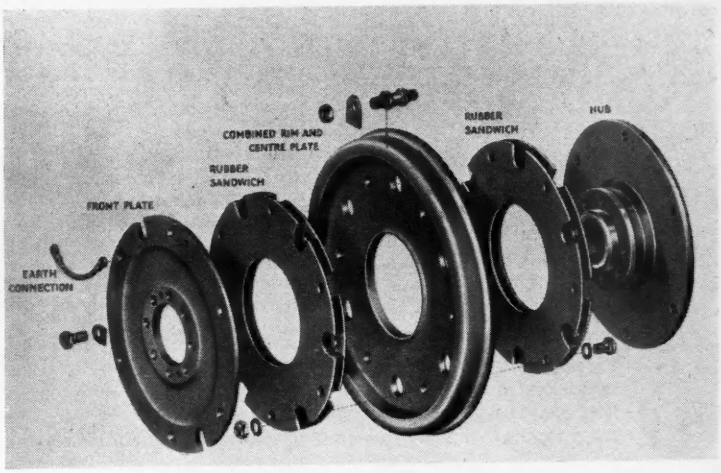
Right: One of the early trolley-buses

Below: 1900 battery electric brougham still in first class running order





Maley & Taunton bogie of the latest type with resilient wheels



Components of the resilient wheel

what originally were purely traction power stations, and many stations relied for their economic operation on the street traction load supplied at high load factor. An idea of the size in 1910 of some of these urban electric transport systems can be gauged from the following examples:—

Bradford City Tramways used 10,076,417 kWh compared with 9,021,344 for general public supply. At Leeds, 14,753,205 kWh was used for traction and 12,421,164 for public supply. Glasgow traction used 26,860,126 kWh at a load factor of 37·58 per cent whereas public supply took not a great deal more at 36,479,243 with a load factor of 19·18 per cent.

The use of electricity in general public supply expanded enormously after the 1914-18 war but even so we find, for example, that in 1939 the traction load in Sheffield amounted to 42,930,895 kWh, which approximately equalled the use of electricity for general purposes in such medium-sized towns as Eastbourne, Reading and Tunbridge Wells and greatly exceeded, as further examples, that of Cheltenham and Gloucester.

Erroneous Argument Accepted

The peak in the number of tramcars or electric rail cars in use in this country was reached in 1925-26 when this form of transport became subjected to strong competition from trolley-buses and motor-buses. Unfortunately, urban transport authorities in this country fell into the trap of accepting the claims put forward by interests selling different types of vehicles that they were suitable for all urban transport needs. It produced the battle system, of one versus the other, on which transport decisions were and are still made in this country. The truth is that each type of vehicle has its place in a large and efficient urban transport undertaking. This fundamentally important aspect of public transport is recognised by many transport undertakings abroad. Toronto and Chicago spring to mind as excellent examples of cities using modern electric rail cars, trolley-buses and motor-buses. Constant improvement of all these systems is the policy they follow.

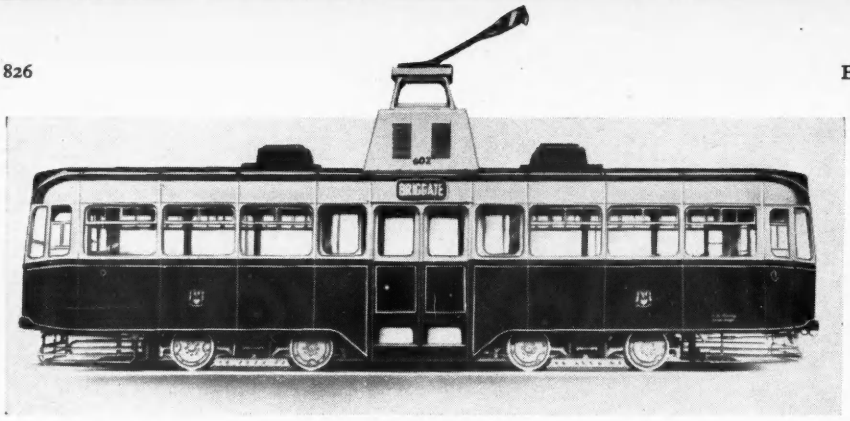
After the early 1920's comparatively little was done in this country to keep tramway systems up to date; indeed the electrical industry appeared to lose interest in that form of traction and took the view that the trolley-bus would be the successor. Good as the trolley-bus is, with its many advantages over the motor-bus, time has proved that the policy of setting the trolley-bus up as a competitor of the railed system, instead of as complementary to it, was not the right one.

Having no powerful body in this country to uphold its virtues and interests the tramcar has had to last out purely on its own merits. The wonder therefore is that it has lived so long with vehicles that are often 30-40 years of age and still giving good service. Furthermore, a fact forgotten is that during the last war transport undertakings were asked by the Government to run their electric traction systems to the maximum possible extent so that imported oil which was severely rationed for motor-buses might be saved. This resulted in tramway systems suffering severely from lack of maintenance, as they did during the 1914-18 war, but they kept running, and in London they earned a great reputation for reliability during the air raids. Arrears of maintenance were never made good and ironically transport reserves built up by the tramways were in a number of instances used to make good losses incurred by motor-buses.

In this country tramways have been continuously penalised by antiquated legislation dating back to the 1870 Tramways Act, which placed on them the burden of road maintenance between tracks and 18in on each side. As road surfacing now has to be carried out to costly standards necessary for heavy motor-vehicle traffic, tramways have borne the cost of maintaining much road surface for other traffic. The rating burden has also been heavy and in the case of one large city undertaking it added roughly 1·3d per vehicle-mile to running costs, while road maintenance added approximately 0·84d per vehicle-mile. This money goes back into the local citizens' pockets but it seems almost impossible to get local councils to appreciate this fact and take it into account. Trolley-buses are also generally burdened with heavier rates than motor-buses and legislation is also restrictive in a number of ways.

New Development

The evolution of that excellent vehicle the trolley-bus is not quite so clear cut as that of the tramcar. It is claimed by F. Hentzenberg in an article in a German electrical journal that in 1881 a vehicle made by Siemens & Halske which resembled a horse drawn hunting carriage was driven electrically in Berlin by current obtained from suspended wires. The claim is supported by a picture showing an upstanding pole in the centre of the vehicle, from the top of which a wire is attached and connected to a device on the suspended wires.



Recently built (1953) electric railcar with resilient wheels and other noise eliminating features

Bradford and Leeds were the first places in this country to operate trolley-buses, both cities putting them into operation in 1911 to act as feeders to their tramway systems. Leeds subsequently abandoned this form of transport but Bradford carried on and now operates one of the most successful trolley-bus systems in the country.

The ill-effects of the last war on electric tramway systems have been referred to; it also had a bad effect on the trolley-bus which, like the tram, carried the main passenger transport burden in its centres of operation.

While the life of a trolley-bus is not so great as that of a tram, it is greater than that of a motor-bus. All these old electric passenger vehicles, still able to carry on giving valuable service, were to their detriment compared with shining new motor-buses, the irony of the situation being of course that motor-bus fleets were the first to wear out and to require renewal after the war. From 1930 until the outbreak of war the number of new trolley-buses being put into service in Britain was increasing at an accelerating rate.

The outstanding case of the effect of the war on trolley-bus development is that of London, where the London Passenger Transport Board after taking over the passenger transport services in the capital in 1933 adopted the policy of changing over from tramways to trolley-buses. When war broke out the conversion had been completed with the exception of a large section serving much of South London, part of the embankment and a short section through the Kingsway subway. The war halted the full conversion, which subsequently became conversion to diesel buses.

To survey the historical aspects of electric road traction the world over is beyond the scope of this article, but the fact stands out, and must be emphasised, that in many progressive countries electric rail car and trolley-bus systems have been constantly improved and kept up to date.

Big Advance

Some few years ago a big advance in street car design took place in America when a new street car was "launched" on the occasion of a conference of presidents of transport authorities which resulted in its being known as the P.C.C. (Presidents' Conference Car). Of the many improvements in this car the outstanding feature was that it is practically silent, completely doing away with that tram noise which the lay Press exulted in writing about when the last tram was withdrawn from service in London. The astonishing silence of the P.C.C. was mainly achieved by the insertion of a rubber section between the steel tyre and the hub: it is sometimes called the sandwich wheel.

Many countries have now adopted the P.C.C. design or modifications of it. Blackpool in this country has in recent years built a fleet of 25 cars based on the P.C.C. design with rubber insert wheels and one of similar type was built by Leeds for experimental service operation.

The first d.c. traction motors used for electric street cars were of the open type, but they were soon found to be unsuitable and the totally enclosed type giving protection from road dust and the weather was introduced. Due to the absence of commutating poles, commutation was very poor and because of their total enclosure their continuous rating was low. Their weight was just over 100 lb/h.p. (one-hour rating) compared with a modern frame-mounted, cardan shaft drive, rail car motor weighing approximately 15·5 lb/h.p. on the one-hour rating. It has to be pointed out that much of the saving in weight results from the different method of mounting and drive employed. In traction, weight reduction is very important and whereas trolley-bus motors had a weight in 1922 of 45 lb/h.p., the weight is now 11 lb/h.p. on the one-hour rating.

The first few years of the century saw the introduction of motors with commutating poles and self ventilation, and the box frame began to supersede the split frame which required more space and was not so good magnetically. The continuing improvement of the d.c. traction motor included the use of ball and roller bearings, woven glass insulating tapes, special varnishes, lightweight castings, with the introduction of aluminium and magnesium alloys for lightly stressed and non-magnetic parts, all combining to produce the modern, very efficient and relatively high power: weight ratio traction motor.

Early tramcars were equipped with two motors of $7\frac{1}{2}$ h.p. to 10 h.p. To-day, one of the latest rail cars built for Leeds and already mentioned has four motors each of 45 h.p.

Control equipment has evolved from the simple drum type controller, which was satisfactory for the early motors of relatively low horse power, to a completely new system of control having 90 resistance steps which are used for starting and for rheostatic braking. The seated driver's controller takes the form of a lever at his side. The simple operation of pushing the lever forward gives varying rates of acceleration; backward movement of the same lever gives varying degrees of braking; bringing it hard back puts the emergency braking circuits into operation.

Tremendous advances in truck design have taken place of late years. Amongst the many improvements incorporated are numerous noise-eliminating features. Wheels are of the new resilient or rubber sandwich type: the introduction of rubber between body and trucks and elsewhere eliminates the familiar noise of the old time tram; furthermore, wheel and track wear are reduced, and a slight lateral flexibility reduces impact blows to the axle and coach structure. Other outstanding results are weight reduction and improved riding characteristics.

Originally, trolley-buses were called trackless trolley cars, an indication that they were virtually tramcars without tracks. After an evolutionary period it was realised that trolley-bus operation required equipment specially designed for the purpose, and foot operated contactor gear giving the driver control of the vehicle by means of a pedal-operated master controller was adopted. Two motors as used with early tramcars gave place to one-motor trolley-buses. The "regenerative" compound

wound motor providing rheostatic or electric braking is the type most generally used because of the efficient braking provided, combined with saving of brake lining wear.

Trolley-buses of the most advanced design have recently been put into operation by Walsall Corporation. They are the first 30ft 70-seater two-deck trolley-buses to be used in this country. Hitherto, three axles have been necessary here for this size of vehicle. Much weight has been saved and considerable running economies are anticipated. The control gear incorporates automatic acceleration. Each vehicle is powered by a 95 h.p. motor.

The great advances in the design of electric road vehicles and the many advantages they confer on the community which include their silence and fumelessness in noise-racked, air-polluted city streets and their beneficial effect on local and national economy are not fully realised in this country; when they are, great expansion in the use of electric traction must take place.

Aircraft Electrical Equipment

Report of Proceedings at Concluding Sessions of I.E.E. Convention

CONTINUING the report of the three-day convention on the electrical equipment of aircraft which was held at the Institution of Electrical Engineers from 2nd to 4th May, we publish below summaries of the papers and discussions at the remaining sessions. At the first two sessions (see *Electrical Review*, 11th May, page 769) the subjects discussed included past and present practice and future trends in equipment design; factors in the utilisation of electrical power in aircraft; and aircraft radio power supplies.

ELECTRICAL SYSTEMS

The third session was devoted to four papers on different systems. The first paper, by A. Ball and R. N. Lake of Saunders Roe, Ltd., described the medium-voltage d.c. system in aircraft and its application in the Princess class flying boats. The second, by P. L. Cronbach of Handley Page, Ltd., dealt with rectified a.c. generating systems. Rectifiers for higher temperatures are thought to be urgently required. A constant frequency a.c. system was covered by P. C. Finucane of A. V. Roe & Co., Ltd. This is said to meet the need for a maximum power/weight ratio better than any other. Air-turbine and hydro-mechanical drives show the most promise.

The last paper of the session by D. C. Flack of the Bristol Aircraft Co., Ltd., was entitled "Future Trends in Aircraft Electrical Systems." Future choice is between the direct variable frequency drive and the constant frequency hydro-mechanical drive with a self-contained auxiliary power unit as an alternative.

Discussion

Mr. V. A. Higgs (British Thomson-Houston Co.), in opening the discussion, said that in some degree or other all four papers suggested that it would be better to use a.c. There was really only one indisputable reason, and that was that a.c. equipment was simpler and more robust, but he had experienced very few electrical failures with d.c. machines, whilst mechanical failure did not recognise the difference between a.c. and d.c. They were heading for aircraft with ambient temperatures of 150 deg C, so they were told, and there they would have to use a.c. It was to such aircraft that he had been referring the previous day when he had spoken of aircraft with 100 hours' life. With civil aircraft one needed at least 1,000 hours' life, and for consistently long life one had to simplify, which one was not doing in going to a.c.

Mr. J. F. Lewis (Ministry of Supply) hoped that in future they would not get radio equipments designed for all sorts of different supplies.

Mr. P. L. Cronbach said that the future of cables at high temperatures seemed doubtful. Once one got over 250 deg C there did not seem to be any form of rubber-like material likely to be available. If they went to mineral-filled cabling, the insulation would become prohibitive in weight. They might be forced to cut out methods of data transmission, including data sampling, to reduce the number of channels running about the aircraft.

Mr. A. W. Ford said that as standardisation was very much in the melting-pot they ought carefully to consider higher frequencies before committing themselves to 400 c/s. Weight reduction was pushed to its extreme in the case of the guided weapons where a power generation frequency of 2,400 c/s seemed to be considered desirable. Since aircraft were rapidly evolving into guided weapons in many respects, the same trend might apply in the case of the generator frequency. The advantage of using 800 c/s would be that the weight of the generator, transformers and transductors would be reduced.

Mr. E. E. Robinson said that compounding for excitation involved some difficulties, but, having done the job, it should give a system with a much quicker response, a much more efficient power output and a lighter arrangement.

Mr. R. J. Wraith (Air Registration Board) said a rig test could never replace flight experience, and recent proving trials showed that any amount of flight in temperate climates was not representative of flying world routes. On airworthiness grounds alone, something more like 2,000 hours' flying on two or more aircraft was the minimum acceptable standard after all the rig testing, and even then there might be many teething troubles.

Mr. E. P. Fairbairn (General Electric Co., Ltd.) said that, on the subject of constant-speed drives, there was a good case for operating such things as undercarriages and flaps, and also power-assisted flying controls, by hydraulic means, which might still be controlled electrically. That seemed to be the more direct method than by electric linear actuators, and it relieved the electrical system of most of the intermittent very heavy loads which might be difficult to deal with.

Mr. S. S. Hall said that the rectified a.c./d.c. system was the only generator system which had proved itself to be capable of operating at high altitudes. Whether it could be further developed was largely a matter of whether the component designers could do anything about the tremendous amount of cooling air which was required for large rectifiers. At cruising altitude the transformer rectifier units required for 100 kW output d.c., 130 lb of air mass flow, and that mass flow was responsible for another 60 lb momentum drag on the aircraft.

Mr. R. T. C. Tarr said that in spite of all the arguments about high voltage or low, a.c. or d.c., the aircraft electrical designer was faced with a very restricted choice which was dictated by two-fold circumstances—the requirements of the particular aircraft, and the availability of equipment. Mr. S. Lucas agreed that there was no choice. The rectified a.c. system met a need and the advent of silicon rectifiers was bound to make a great difference. Messrs. T. E. Sims and L. G. Hill also spoke.

Mr. R. N. Lake, in replying to the discussion, said it was

interesting to note that the majority of those who had spoken had been concerned with points about the a.c. systems, and he thought there was a moral in that.

MACHINE EQUIPMENT

In the fourth session three papers on machine equipment were delivered, the first being by R. H. Woodall, P. J. Daglish and V. A. Higgs on " Trends in the Development of Airborne Electrical Equipment with Particular Reference to Constant Frequency A.C. Systems." Future requirements, it states, can only be met by such a system, at 400 c/s preferably; and cooling needs major attention. " Electrical Machines for Aircraft " by B. Adkins, W. Philipp and A. Hossle, deals with certain special machines and " The Cooling of Aircraft Electrical Equipment " by C. S. Hudson reviews this subject. Cooling by blast air becomes inadequate at speeds in excess of 1,000 m.p.h. owing to kinetic heating and at altitudes above 60,000ft because of reduction in mass flow. Methods of surmounting the thermal barrier are discussed.

Discussion

The discussion on this session was opened by Mr. W. R. Hinton (R.A.E.), who criticised the Beier drive referred to by Woodall, Daglish and Higgs on the ground that there was no automatic and inherent method of sharing the torque loads between the two friction discs, and suggested as an alternative mechanical drive the Hayes gearbox, used by Austin Motors before the war, which was very robust and had a built-in system which automatically shared the load between the friction members. Much that Mr. Hudson had said on air cooling could be applied in future to liquid-cooled machines.

Mr. H. West (Rolls-Royce) maintained that the engine maker was certainly not going to allow electrical engineers to use his fuel for cooling their generators. He deprecated the undue emphasis placed on weight as against reliability.

Mr. J. S. Holmes agreed with Mr. West and did not agree with Adkins, Philipp and Hossle that weight should be the first consideration. The emphasis put on weight made it a long and difficult development problem to get a life of 1,000 hours out of a new design. It would be a change to have a new machine which on first test gave a life of 2,000 hours and where the development problem was to reduce the weight commensurately with a reduced life of 1,000 hours.

Mr. E. Lloyd (Air Registration Board) suggested that the built-in fuel-air heat exchanger for alternator cooling referred to by Woodall, Daglish and Higgs would be subject to obvious dangers of both fire and explosion. They had recently analysed the defects on a whole range of equipment in a number of civil aeroplanes, and found that amongst the least reliable equipment was the continuous-running d.c. motor; intermittently-rated motors were much more reliable.

Mr. A. Sarup, commenting on the suggestion by Woodall *et al.* that electrical engineers should raise the maximum temperature at which their equipment would operate, pointed out that this was determined by the materials available to them, and at present they were limited to the silicone materials. It was strange that most of these had still to be imported from the U.S.A., and some of them had a storage life of only about three months.

Miss B. Shilling (R.A.E.) thought that speakers had been unduly harsh on the air turbine drive in comparison with the mechanical drive. She would not expect the fuel consumed to be more than double the quantity required by the mechanical drive, and with further developments the position would improve. The mechanical engineer was often accused of not appreciating power factors and reactances, but it seemed to her that the electrical engineer did not understand thermal efficiency.

Mr. C. G. A. Woodford attributed most of the unreliability and the difficulties associated with aircraft systems to what he regarded as the senseless desire to run things in parallel. There had even been mention of paralleling the duct for the hot air. He gathered that this hot air was at a temperature of over 500 deg C, so that if it got out it would melt the structure of the aircraft.

Dr. D. C. Flack described the suggestion that a variable-speed d.c. motor could be replaced by an a.c. motor with variable gear as fantastic. The a.c. motor, he said, had many real advantages, so that there was no need to invent any. The high starting torque of the d.c. motor was a very important feature.

Mr. H. Zeffert said that whether a.c. or d.c. was used must depend on the needs of the aircraft and not be the subject of a dogmatic decision by component manufacturers. Their preference for a.c. seemed to be due to preoccupation with the needs of supersonic aircraft, of which there would never be large numbers, but the needs of civil aircraft, of which the numbers increased day by day, must be studied.

Mr. J. R. Ewans (A. V. Roe) said that for supersonic aircraft it was necessary to start thinking of liquid cooling. He did not suggest using the fuel directly, but equipment must be provided which was cooled by its own fluid, and the aircraft constructor would make arrangements for the cooling of that fluid, probably with the aircraft fuel—which, he pointed out to Mr. West, was the aircraft manufacturer's property until it was fed into the engine.

Mr. W. W. Westacott and Mr. P. L. Cronbach also took part in the discussion, to which the authors replied.

SYSTEM EQUIPMENT

The fifth session on the subject of system equipment included eight papers in all. " The Electrical Characteristics and Protection of Aircraft Power Systems," by K. J. Payne, considers the steady state and transient characteristics of the power supply equipment and the utilisation equipment, and determines the effect of disturbances and the protection against faults. " Aircraft Switchgear " by W. G. Bourne and A. Grieve examines future trends necessitated by greater speeds and heights and states that a.c. systems should ease matters since short circuit powers are reduced. D. W. Bird, D. C. Hancock and D. B. McKenzie in discussing " Aircraft Electrical Cables " indicate future needs and designs.

" The Development of Voltage and Frequency Regulators for Aircraft Electrical Systems " by C. W. Cooper outlines the history of the subject and possible future developments. " Aircraft Batteries and their Behaviour on Constant Potential Charge " by G. A. Earwicker deals with lead-acid, nickel-cadmium alkaline, and zinc silver-oxide and compares them. Increased performance is obtained at the cost of greater sensitivity to changing conditions.

" D.C. Circuit Interruption and Arc Characteristics at Low Air Pressures " are dealt with by A. H. M. Arnold and L. H. Ford who show that comparable switch performance at lower pressures can usually be obtained either by an increase of gap length or in the number of series breaks. I. A. Mossop and F. D. Gill in " The Current and Voltage Relationships of a Stable D.C. Arc Between Copper and Silver Electrodes in Air at 1-760 mm Hg " show that at pressures below 50 mm Hg the difficulties of interrupting a current increase rapidly, and that lengthening the gap is ineffective. The experimental results for each electrode material are expressed algebraically and in a nomograph. The last paper of the Convention by N. C. Adcock and A. W. Ford entitled " Excitation Systems for A.C. Aircraft Generators " briefly reviews the methods of exciting a.c. generators and points out the advantages of a.c. exciters.

Discussion

Mr. R. J. C. Tarr (English Electric Co.), who opened this session's discussion, said the fundamental problem was how the aircraft constructor might more accurately specify his requirements to the equipment manufacturer.

Mr. P. R. Dunn (British Insulated Callender's Cables, Ltd.) said it was significant that so few examples could be given of an aircraft cable where one single, simple material was used as insulator without need for further protection. The majority of cables represented a compromise between the properties of one material and those of another, used perhaps to reinforce the deficiencies of the first.

Mr. E. E. Robinson expressed surprise that so little had been said about the use of magnetic amplifiers. Mr. Cooper had made no reference to them when discussing variable frequency supplies, and there seemed to be a general impression that when the frequency wandered a little off the optimum design value, magnetic amplifiers could not be used. This was not true.

Mr. W. H. P. Leslie described the complicated conversions from a.c. to d.c. and back again throughout an aircraft and commented on the paper by Mr. Cooper. He asked why it was necessary to regulate the frequency to 1 or 1½ per cent and suggested that it was because some radar designer had said he could save 2 lb and two valves if he had a supply of constant frequency. It should not be possible for an equipment designer to achieve a small saving in weight, if the reaction on the aircraft was to add 10 or 100 times the weight elsewhere. There seemed to have been no single authority who could make an overall assessment of the system before such a procedure was allowed.

Commenting on this, Mr. S. F. Follett, the Rapporteur, said that if Mr. Leslie knew of the efforts to do something about this for years he would be surprised.

Mr. Sylvester (Vickers), referring to the paper on aircraft batteries, complained that there was no battery which completely answered their demand, especially on the American continent, where aircraft operated under intensive and often adverse conditions. They were finding that the British battery was not soundly constructed and there had been a tendency to go for a general lightening of the battery, unaccompanied with such a cost reduction that, on failure, the operator could afford to throw the battery away.

Mr. Earwicker, replying to this, and referring to developments and improvements which were taking place said he could not promise a battery that would never give trouble in any circumstances.

INSTALLATION AND MAINTENANCE

The concluding session took the form of a discussion on installation and maintenance of aircraft electrical equipment. It was opened by Messrs. C. C. Jackson, A. J. Cope, and R. D. Jones. In the opening remarks it was suggested that *in situ* maintenance should normally be unnecessary since with few exceptions equipment should operate for 1,000 flying hours without attention.

Mr. J. H. Rea (Rotax, Ltd.), continuing the discussion, while sympathising with the airline operators' objection to doing development work, did not think that there was any alternative to flight testing. What was more important than a probable life of 1,000 or 2,000 hours, was consistency. A consistent life of 500 hours without failure would be more valuable to the operator than a probable life of 2,000 with failures at 200. The accessory manufacturer could do something to achieve this by careful quality control.

Mr. H. F. Bloodworth (Air Registration Board) pointed out that all the development work put into circuit analysis and equipment design could be spoilt if there were not sound interconnecting media. During the past ten years they had had continual trouble on many types of aircraft due to corrosion of plugs and sockets. Considerable development was also required in cable terminations, and Mr. Jackson's suggestion of using a combination of copper and aluminium for busbars should receive further consideration.

Mr. H. P. Fairbairn (G.E.C.) suggested that the electrical and hydraulics engineers should get together. He agreed that plugs and sockets caused more trouble than any other component, and described it as criminal to take a bare wire, twist it round a terminal and screw it up.

Mr. L. H. Hildebrandt (U.S.A.) said it had been enlightening to find that many of the problems met with in this country were those which caused trouble in the United States. Vibration troubles were likely to increase, even with jet and turbo-prop aircraft. On the question of high-temperature operation, their interim programme was for equipment to operate at 600 deg F, and their long-term programme was for 1,000 deg F operation. He thought the objective should be to have rotating equipment and wiring which would operate when red hot. There was a place for d.c. in commercial aircraft, but he doubted whether d.c. would have much place in future in military aircraft. Tremendous progress had been made in America with constant speed drives, which in many instances had given a life of 2,000 hours, as compared with about 10 hours in 1942.

Mr. F. F. Cook (Air Registration Board), while agreeing that it was desirable to reduce the number of plugs and sockets, said that because of the demand for higher performance from instruments and other devices their number was increasing. Owing to the collision risk in the air, pilots were demanding altimeters of much greater accuracy, which would mean the use of electric data transmission and computation and involve the use of plug and socket, as did also the air-speed indicator and the artificial horizon. The designing of new and more satisfactory plugs and sockets was even more important than the development of new generating equipment.

Mr. H. Zeffert (Vickers-Armstrongs Aircraft) pointed out that a large amount of "electrics" had to be used to protect "mechanics." On a recent job, of 12 lights to indicate whether it was working satisfactorily or not ten were concerned with whether it worked mechanically. The work being done by the R.A.E. on brush wear was outstanding, and might go some way towards reinstating d.c.

Mr. Brooksmith claimed that not enough young men were being trained in installation engineering, and Mr. M. V. Cooper made a plea for something better than now existed for insulation testing. Mr. P. N. Neville urged that someone should have the responsibility for considering the installation as a whole at the earliest possible point in the design of a new aircraft from the point of view of its effect on the compass.

Mr. M. Hancock (R.A.E.), referring to comments made at previous sessions on the shortcomings of the carbon-pile voltage regulator, mentioned two statistical surveys recently conducted at the R.A.E. The first was applied to a special regulator used on R.A.F. planes for controlling the supply to a piece of armament equipment. It regulated nominally at a 22 V level. In a survey of 40 planes chosen at random the voltages spread from 18 to 26 or 28.

Wing Commander C. W. S. Pringle (Air Ministry) said that in the past electrical systems had not been up to the standard of reliability which they had hoped to get, thus wasting precious manpower and often making it necessary to install emergency devices which added to the weight carried. For example, they were having to inspect some generators every 25 hours for brush wear, and owing to inaccessibility they had to be taken out to be inspected, an intolerable situation.

All three openers briefly replied, and Mr. B. L. Metcalfe, in thanking them, said that in the mining industry, to which he belonged, he found that colliery electricians had the same kind of sardonic humour as the openers possessed, and which might be born of having to reconcile the statements of manufacturers with the actual facts.

Fire Precautions in Hospitals

A circular has been issued by the Ministry of Health dealing with hospital fire precautions. This contains general advice to hospitals and analyses the causes of fires. Smoking is responsible for more than 18 per cent of fires, but other important causes are quoted as fires in grates, and electrical and gas apparatus. The circular points out that the amount of electrical equipment in use tends to increase continuously, often without careful inquiry into the capacity of existing circuits to bear the additional loads, and recommends frequent testing of old installations. The use of pilot lights is recommended in socket outlets serving electrical apparatus where the heating element is not visible.

I.E.E. Annual Report

THE annual report of the Institution of Electrical Engineers for 1955-56 which was presented at the 84th annual general meeting of the Institution yesterday (Thursday) indicates that the rate of increase in membership has been well maintained, but there are still insufficient entrants to the profession to meet the national need. Means of remedying this situation are being actively sought and the subject of technological education has therefore been of considerable interest to the Council and has received much attention from the Joint Advisory Committee on Education of the three senior engineering Institutions. The Council has introduced a number of measures which it is hoped will increase the number of applications for student membership. These include the introduction of a small lapel badge for graduates and students and, for all members, an Institution tie. As a result of the Council's interest in the provision of adequate courses for electrical technicians and of the conference on this subject which it sponsored, the City and Guilds of London Institute has prepared regulations and syllabuses for the conduct of examinations for electrical technicians.

The 13th edition of the Wiring Regulations was published last September and so far over 40,000 copies have been sold. The Council has authorised the preparation of a fourth edition of the electrical regulations of equipment of ships. The British Nuclear Energy Conference was inaugurated on 30th November last and the first issue of the journal of the Conference appeared last January; there will be two further issues this year and it is likely thereafter to appear quarterly.

The number of members of the Institution elected during the year was 1,978 compared with 2,200 in 1954-55. The membership committee dealt with 2,836 other applications, mostly for transfer from one class to another, making a total of 4,814 compared with 4,374 in 1954-55. The membership is now 40,038; the number of corporate members exceeds 20,000 and the number of graduates increased during the year to 11,797.

The Council elected Col. Sir Arthur Stanley Angwin (past president) to honorary membership of the Institution and the 34th award of the Faraday Medal was made to Emeritus Professor G. W. O. Howe.

During the year 1,270 meetings of members, the Council and the various committees were held in London and at the local centres. Eight ordinary meetings were held in London, with an average attendance of 310 as compared with 314 for the previous year. A number of joint meetings with the Institution of Civil Engineers and the Institution of Mechanical Engineers, two extra meetings, the annual general meeting, and two special general meetings were also held.

The Council has reviewed the scope of the Specialised Sections and agreed that the work of the Electrochemistry and Electrometallurgy Committee and the Traction Committee should be taken over by the Utilisation Section Committee, and that of the Telegraphs and Telephones Committee by the Radio Section Committee, which has been renamed the Radio and Telecommunication Section. In addition, the title of the Measurement Section has been changed to the Measurement and Control Section to provide a more appropriate description of the ground covered. The membership of the Sections continues to increase; particulars of this growth and of the activities of the Sections are summarised in the accompanying table.

	Membership at 31st March, 1956	Number of meetings	Average attendance (figures for last year in brackets)
Measurement and Control ...	2,661	15	61 (65)
Radio and Telecommunication	5,232	15	152 (134)
Supply	4,685	10	147 (157)
Utilisation	4,145	8	120 (112)

During the year 328 meetings of a general character were held by the ten local Centres and their Sub-Centres and specialised groups. In addition, a number of social functions were held, at several of which the President was present, accompanied by the secretary. The vice-presidents visited all 21 Centres and Sub-Centres and also deputised for the President at social functions which he was unable to attend.

The East Anglian Sub-Centre, which came into operation on 1st October, is now holding meetings regularly in Norwich, Ipswich and Cambridge. The opening meeting in Norwich on 12th October was attended by Mr. T. E. Goldup, C.B.E., vice-president, and the secretary of the Institution, together with other members of the Council.

The attendance at the annual dinner each year continues to increase and a record total of 1,472 members and guests were present at the function this year. This was a particularly memorable occasion as the principal guest was H.R.H. the Duke of Edinburgh.

British Standard Smoke Alarms

AS a result of recommendations made by the Beaver Committee on Air Pollution, the British Standards Institution has now issued B.S. 2740, which deals with simple smoke alarms and alarm metering devices. It is the first of a series of standards which the Institution has been asked to prepare, and is designed particularly to help the smaller manufacturer to combat air pollution and economise in fuel.

During the passage of the Clean Air Bill through the Commons, a clause was inserted enabling the Government to make regulations requiring smoke measuring instruments to be installed and used. Complex measuring equipment (for which another standard is being prepared) has been available for a number of years, but because of its relatively high cost it has often been beyond the reach of some firms. The present publication will help the smaller firm in this respect.

The instruments covered in B.S. 2740 normally consist of three fixtures to be installed on industrial chimneys: (a) a light source such as a lamp and projector, (b) a receiving unit consisting of a photocell and amplifier, and (c) a visual or aural alarm. When the alarm bell rings or the light flashes, it will be the responsibility of the plant operator to adjust firing conditions so that smoke will be reduced. In addition to the alarm mechanism, two kinds of simple metering device are specified which can be used to record the number of alarms given and their duration. Records from such meters could be used by manufacturers as a defence in any action brought against them under the Clean Air Bill when it becomes law.

It is important to note that the instruments specified in the new standard will only record black or grey smoke, not white or coloured smoke; nor will they be suitable where boilers are fed with pulverised fuel.

Copies of the new standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 3s.

VIEWS on the NEWS

By REFLECTOR

IN the United States the electric power corporations still hold their separate annual convention under the auspices of the Edison Electric Institute. This Institute's main objects are to advance the "art" of producing, transmitting and distributing electricity and to aid its members "to generate and sell electric energy at the lowest possible price commensurate with safe and adequate service, giving due regard to the interests of consumer, investor and employee." As with the British Electrical Power Convention the E.E.I. Convention has a theme. This year the Convention is at Atlantic City, N.J., and the theme, as stated in the Institute's *Bulletin* is:—"Tell Our Story —Go Forward! Clearing and Widening the Expressways of Electric Power! For America!" Our own Power Convention theme, "Electricity and Transport" seems rather pallid in comparison with this.

* * *

I am in agreement with Mr. F. C. Hooper when he objects to the spate of letters to the Press making serious but ill-defined criticisms of British manufacturers and their attitude to export business. Writing to the *Economist* he says:—

> "Our national sport of self-denigration is a pastime little relished by British manufacturers determined to expand overseas markets. Both at home and abroad, it is tending to undermine the confidence on which our economic future depends."

We are always being told that "there is no room for complacency." There is even less for this kind of thing which not only depresses the exporter but is also an extremely bad advertisement for the country.

* * *

In their "Report and News Letter" dated April the Friends of the Lake District make it clear that, so far from endeavouring to prevent the extension of electricity supply in the area, they are anxious that Lakeland dwellers should not be deprived of its benefits. They say:—

> "The first reaction of the North Western Electricity Board to the restriction of credit appeared to be that rural electrification, as the form of capital expenditure giving least return to the Board, must take the brunt of the squeeze. Orders were even given to hold up the work actually in progress in the lower part of Langdale. The local storm this aroused had a salutary effect and the work was continued at the last moment. Borrowdale similarly was to be postponed and no date given for restoring the scheme."

The Friends stressed in various ways the point that a nationalised industry at the least had no right to give a "low priority" to the vital interests of any part of the population, and as a result the Borrowdale scheme has once again a date in the programme. I can quite understand that the Board felt that the difficulties which it had encountered justified deferring the Borrowdale scheme. The insistence that a substantial part of the transmission should be underground, however justified, certainly threatened to add to the cost at a time when funds were being cut. It is greatly to the Board's credit that it has decided to go ahead in spite of this.

* * *

It is customary when a journal quotes substantially from another to make some sort of acknowledgment. The rule is often broken, of course, and the chief offenders are usually foreign journals. Occasionally they unwittingly give themselves away as, for instance, in an Indian journal which I have been looking at. One page is devoted to an article lifted bodily from the *Electrical Review* without any indication of its source or any illustrations. Unfortunately the editor failed to notice a sentence which began "we are now able to reproduce a photograph . . ." His readers are now probably wondering where the picture got to.

* * *

The *Star* reports that the Mitcham Council has "noted" a suggestion from the local branch of the Electrical Trades Union that the Mayor's chain and the official mace should be melted down and used for a more useful purpose. This suggests to me an adaptation of a slogan popular with the E.T.U.:—"Mayors of the world unite; the unions are after your chains." I also wonder what more useful purpose the branch had in mind.

* * *

In the 14th May, 1886, issue of the *Electrical Review*, a report appeared of a pamphlet "Electricity Analysed" by a William Boggett who was described as ". . . aetat 90; he hails from Chelsea, and is best known in connection with some experiments of an interesting nature which he performed with the aid of his niece, to show that the electric state of males and females respectively is essentially an opposite one." The note goes on:—

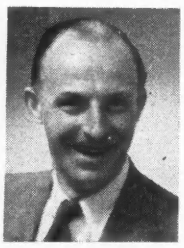
> "Dealing in this, his latest production, with matters with which we have a more intimate acquaintance than with the above, this latter-day Chelsea sage thus learnedly proceeds: 'Messrs. Gaulard and Gibbs have proved the great amount of electricity in the atmosphere by the large quantity they obtained from a dynamo to light several stations on the Metropolitan Railway being passed into the *primary wires without loss*, but went on without any diminution into the secondary wires, from which the supply of light was given to several stations on the line. The secondary wires, therefore, could only have received its lighting power by induction from the atmosphere.' We should have been inclined to attribute the high percentage of return in the Gaulard-Gibbs apparatus to the employment of this atmospheric dynamo were it not for an admission made by Mr. Boggett, which somewhat shakes our faith in him. He candidly says: 'As an uneducated man I deem it proper to apologise for advocating opinions directly at variance with those held by the highest scientific authorities.'"

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Lord Citrine, chairman of the Central Electricity Authority, and the delegation of nineteen which he led on a tour of Russian power stations and electrical installations, arrived back in London in the new Russian ship s.s. *Molotov* on Monday. Lord Citrine said that their 5,000-mile tour had produced a great deal of goodwill and there might be further interchange of visits between electrical engineers in Britain and Russia.

Mr. V. A. H. Clements, M.I.E.E., after 32 years' service in the electricity supply industry, is shortly leaving the Central Electricity Authority to take up an important administrative appointment with the Cementation Co. Mr. Clements was appointed assistant commercial manager of the Authority on nationalisation in 1948. He had previously been for seventeen years with the North Eastern Electric Supply Co., Ltd., being power engineer for the last twelve years. Mr. Clements served his apprenticeship with George Kent at their Luton Works and in 1924 joined the staff of Merz & McLellan, with whom he remained until going to the N.E.S. Co. in 1931.



Mr. V. A. H. Clements

Mr. V. Watlington, M.B.E., A.C.G.I., M.I.E.E., attained his eightieth birthday on 5th May and to mark the occasion the Electrical Fair Trading Council, with which he has been associated for many years, presented him with a box of cigars and a bouquet for Mrs. Watlington. Our illustration shows the presentation being made by Mr. L. C. Penwill, director of N.E.C.T.A., Ltd., and a member of the Council since its inception.

Mr. L. C. Penwill (right) presents Mr. V. Watlington with a box of cigars on behalf of the E.F.T.C.

Mr. S. C. Hurry, chairman and managing director of the Jackson Electric Stove Co., Ltd., is retiring at the end of May this year, after 50 years in the industry. He joined the company, after war service, in 1920 and soon after was appointed sales manager; he became a director in 1935.

Mr. S. C. Hurry

Before the 1914-18 war he was connected with commercial development in the Electricity Departments of West Ham, Torquay and Sheffield Corporations. Mr. Hurry's address is 19, St. James Avenue, Ewell, Surrey.

Mr. E. S. Hoare has withdrawn from his position as senior partner of Hoare, Lea & Partners, consulting engineers, to become the firm's advisory consultant. The firm will continue to operate under the same style.

The Metropolitan-Vickers Electrical Co., Ltd., has appointed **Mr. J. S. Hall,** Associate I.E.E., formerly assistant manager of the company's Manchester office, to be assistant manager, Cardiff office. Mr. Hall joined M-V as a school apprentice in 1921, following which he spent two years abroad with Babcock & Wilcox, Ltd. He returned to Trafford Park in 1926, and later held positions in the company's offices in Cardiff, Bristol and Swansea, being appointed manager of the Swansea sub-office in 1949. In 1952 he transferred to the Manchester office staff as senior assistant and became assistant manager there in 1955.

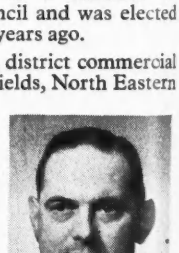
Mr. G. B. Hayward, A.M.I.E.E., formerly manager of the company's Plymouth sub-office, has been appointed manager, Bristol sub-office, in succession to **Mr. H. B. Eccles,** who has reached retirement age but is at present acting in an advisory capacity. The whole of the South-West England area is now served by the sub-office at Bristol, the Plymouth sub-office having been closed. Mr. Hayward gained his early experience with Edmundson's Electricity Corporation, being attached to the Salisbury Electric Light & Supply Co., and attended Southampton University College. On the outbreak of war in 1939 he was embodied with the Territorial Army and served first with R.A.O.C. and later with R.E.M.E., being commissioned in 1943. He joined M-V in 1946 and has been manager at Plymouth since 1951.

Mr. S. F. Steward, C.B.E., managing director of Lancashire Dynamo Holdings, Ltd., has become chairman of Lancashire Dynamo Electronic Products, Ltd.; this subsidiary of the Holdings company has its works at Rugeley, Staffs.

Mr. A. S. Allan has joined Main Refrigeration, Ltd., as area sales manager to represent it in the electrical field. Before joining the company Mr. Allan was with Bendix Home Appliances, Ltd., as divisional sales manager, and for the past three years as London sales manager.

Mr. J. R. W. Rae, district commercial engineer, Durham, for the North Eastern Electricity Board, is to retire at the end of July after thirty-three years in the electricity supply industry. He joined the former Newcastle Electric Supply Co., Ltd., in 1923. Mr. Rae is a member of Durham City Council and was elected an alderman some years ago.

Mr. D. E. Noad, district commercial engineer, South Shields, North Eastern Electricity Board, has been appointed commercial officer of the Liverpool North District of the Merseyside and North Wales Electricity Board. Mr. Noad was educated at the Borough Polytechnic, London, and received his training with Venner, Ltd., with whom he was power station and plant engineer from 1937 to 1940. During the war he was engineer officer, R.N. Transport, and he returned to Venner's in 1945 as area manager, Scotland and North East England. In 1950 Mr. Noad was appointed area commercial officer, Northern Area, North of Scotland Hydro-Electric Board, and he went to South Shields in 1953.



Mr. D. E. Noad

Mr. G. M. Gracewood retired from the service of Electrolux, Ltd., on 30th April after being with the company since 1928. He joined as a refrigerator salesman covering the Northampton, Nottingham and Leicester area,

becoming South London district manager until January, 1955, when until his retirement he was on special duties at the head office in Regent Street, W.1. His colleagues have presented him with binoculars.

The Minister of Fuel and Power has appointed **Mr. D. B. Irving,** B.Sc., M.I.E.E., to be chairman of the London Electricity Board from 1st July in succession to **Mr. H. J. Randall,** C.B.E., F.C.I.S., Companion I.E.E., whose resignation with effect from 30th June has already been announced.

Mr. D. B. Irving

Mr. Irving, who is at present deputy chairman of the Board, received his education at Ayr Academy and London University, and his practical training with the British Thomson-Houston Co., Ltd., with whom (from 1926 to 1932) he held various positions in London, Sheffield, Bombay and Calcutta. In 1932 he was appointed section engineer, Mid-East England Area, Central Electricity Board, and in 1938 became assistant on the staff of the C.E.B. chief engineer. On nationalisation he was appointed construction engineer to the London Electricity Board and in the following year was appointed chief engineer; he became deputy chairman in 1953.

Mr. Irving was a member of the I.E.E. Supply Section Committee from 1948 to 1951 and was awarded the Sebastian de Ferranti Premium of the Institution in 1945. He is a member of the Registration Board of the National Register of Electrical Installation Contractors and also a member of the Electrical Industries Standards Committee of the British Standards Institution.

Mr. R. Appleby, director and general manager of Black & Decker, Ltd., has been appointed director of international operations to the parent company, Black & Decker Mfg. Co., at Towson, United States. **Mr. J. W. A. Meredith** has been appointed export sales manager of the company. This appointment covers the territories of Scandinavia, Europe, North Africa, the Middle East, India, and the Far East. Previous to this appointment Mr. Meredith was the company's representative in the Far and Middle East.

Mr. R. Appleby

Mr. J. W. A. Meredith

At the meeting of the Council of the London Chamber of Commerce on 8th May, **Sir Harold Gillett,** M.C., F.C.A., was elected chairman in succession to the late Mr. Frank Travers. **Mr. A. L. Stock** was elected deputy chairman and **Mr. R. Wills,** M.C., was elected treasurer. Mr. Stock is managing director of the Morgan Crucible Co., Ltd.

Mr. H. J. Beach has been appointed technical representative with the Telegraph Condenser Co., Ltd. He was formerly an officer in the Royal Naval Scientific Service and has had experience with the Edison Swan Electric Co., Ltd., and with Hawker Aircraft, Ltd.

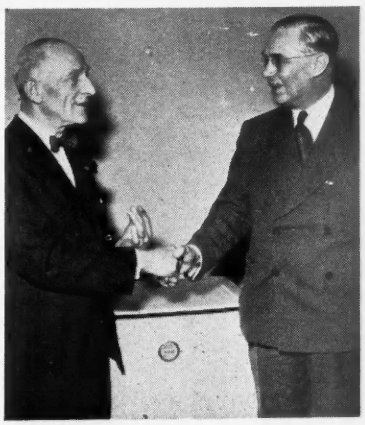
Siemens Brothers & Co., Ltd., announce the appointment of **Mr. J. L. Ilsley,** B.Sc., A.M.I.E.E., as sales manager and **Mr. S. A. Cook** as chief engineer in the recently formed Lamp and Lighting Division. This new division of the company has been formed to absorb the activities of the Lamp, Lighting Fittings and Lighting Engineering Departments of the former company, Siemens Electric Lamps & Supplies, Ltd.

Mr. Ilsley joined Siemens Electric Lamps & Supplies, Ltd., in 1946 as personal assistant to the general sales manager and since 1951 has been manager of the Lamp Department. Before war service in the R.E.M.E. with the rank of major he was with the Metropolitan-Vickers Electrical Co., Ltd. Mr. Cook has had considerable experience in the design, development and production of electrical and electronic products, both in this country and in the United States. He is well known as a designer in the lighting, optical and instrument industries and has had experience in production engineering over a wide field.

Mr. J. L. Ilsley

Mr. S. A. Cook

Mr. W. Bowthorpe has retired after fifty-two years' service with the General Electric Co., Ltd. He joined the company in 1904 and is one of five Bowthorpes who have been employed by the company. Mr. Bowthorpe commenced in the Fittings Department at Queenhithe and in 1909 started as a traveller, continuing in this capacity (apart from service in the 1914-18 war) for the rest of his association with the G.E.C. On his retirement his colleagues presented him with a refrigerator.



Mr. T. W. Heather, director of the G.E.C., presenting Mr. W. Bowthorpe with a refrigerator on the occasion of his retirement

The Lord President of the Council announces that **Sir Hugh Beaver** has expressed a wish to resign from the chairmanship of the Advisory Council of the Department of Scientific and Industrial Research. Sir Hugh will continue to serve as a member of the Council. **Sir Harry Jephcott** has accepted the invitation of the Lord President to become chairman.

Mr. W. L. Wray, managing director of the Wandleside Cable Works, Ltd., left on Tuesday last for the Middle East, India and Pakistan where he is to conclude further contracts for the company and the associate company, Irish Cables, Ltd., Newcastle, Co. Down, Northern Ireland.

Mr. R. A. Pittman, B.Com.(Hons.), A.C.I.S., has been appointed secretary of the British Engineers' Association. For the past eight years Mr. Pittman has been head of the Economic Research Division of the Association. He succeeds **Brigadier J. V. Topham,** whose resignation has been accepted on his taking another appointment.

At a meeting of the Council of the British Radio Equipment Manufacturers' Association on 11th May **Mr. M. M. Macqueen,** at the special request of his colleagues, accepted re-election as chairman of the Association. Mr. Macqueen has been chairman for the last two years and also held the office in 1949 and 1950. **Mr. F. W. Perks** was elected vice-chairman.

Mr. E. C. Holroyde, Companion I.E.E., vice-chairman of Crompton Parkinson, Ltd., has joined the board of Lightalloys, Ltd.

Mr. D. J. Hastings has been appointed export sales manager for Enfield Cables, Ltd., in London. He has recently returned to Britain from Kenya, where he was managing

director of Enfield Cables (East Africa), Ltd., a position which he has held for a number of years.

Mr. G. W. Godfrey, executive director, radio sales, E. K. Cole, Ltd., left for Australia in s.s. *Himalaya* on 11th May. Mr. Godfrey will be appointed a director of the recently announced Australian company to be jointly owned by Associated Electrical Industries, Ltd., and E. K. Cole, Ltd. He will be concerned with the setting up of television and radio set manufacture and liaison with A.E.I. Pty., Ltd., Australia, in regard to marketing. Based at Sydney, Mr. Godfrey, who will be accompanied by his wife, will be away from England for several months.

Mr. G. W. Godfrey

The Manchester area golf competition of the **Electrical Industries National Golf Competition** was held on 2nd May. There were 136 entries and the following prizes were awarded:—Ferranti Trophy, Mr. H. Fletcher; runner-up (Div. 1) Mr. D. Revington, (Div. 2) Mr. G. G. Cooper; best gross, Mr. F. G. Briant; veterans', Mr. H. G. Brown; visitors' best net, Mr. D. V. C. Pott; visitors' best gross, Mr. J. Chew; putting, Mr. G. G. Cooper; 12 hole greensome competition, Messrs. F. Ainscow and C. H. Hodgson.

Mr. T. Powell has been appointed managing director of British Acheson Electrodes, Ltd., in succession to Mr. W. B. H. Gallwey, who was recently appointed chairman of the company.

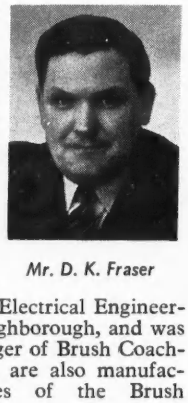
On 28th April the Henley (Birtley) football team were successful in winning the final of the 1955-56 **C.M.A. Cup Football Competition.** Playing on Henley's sports ground at New Eltham, they defeated the cup-holders, Southern United Telephones, by two goals to one. Our picture shows Mr. W. Lewis Smith, president of the Cable Makers' Association Football Cup Competition, presenting the cup to Mr. J. Graham, Henley's captain; Mr. W. A. H. Brown, competition chairman, is in the background.

Mr. W. Lewis Smith presenting the C.M.A. Football Cup to Mr. J. Graham, captain of the Henley (Birtley) football team

On 30th April presentations were made by the Metropolitan-Vickers Electrical Co., Ltd., to a number of employees attaining the recognised period of service with the company. This year so many employees are involved that two evenings were set apart for the presentations, the second function being held on 7th May. The employees qualifying for presentations were four men with 50 years' service and 267 with 35 years' service, and 24 women with 40 years' service and 90 with 30 years'.

At a small informal gathering immediately following the annual general meeting of **A. Reyrolle & Co., Ltd.,** Sir Claude Gibb, chairman, presented gold wristlet watches to fifteen employees, including two ladies, who had completed forty years' service during the preceding year. Four other employees with fifty years' service were each given an illuminated testimonial and a cheque. Sir Claude congratulated the recipients and thanked them for their loyalty to the company, and Mr. A. A. Nicod, a superintendent inspector who received one of the 50-year awards, replied on behalf of his colleagues.

Mr. D. K. Fraser has been appointed managing director of Petters, Ltd., Staines. He succeeded **Captain R. C. Petter,** the former managing director, in April last year, as director and general manager. Before going to Petters, Mr. Fraser was works manager of the Electrical Machines Division of the Brush Electrical Engineering Co., Ltd., Loughborough, and was also general manager of Brush Coachwork, Ltd., which are also manufacturing subsidiaries of the Brush Group, Ltd.



Mr. D. K. Fraser

Riley & Neate, Ltd., have announced the appointments of **Messrs. W. A. Clarence,** Associate I.E.E., **K. Symon, R. J. H. Pearce** and **E. S. E. Lee,** M.I.E.E., as additional directors.

Mr. Clarence is district engineer for the North of England and has been with the company for twenty-two years. Mr. Symon has been with the company for seventeen years and is at present district engineer for the Midlands. Mr. Pearce joined the company in 1936, and after service in the R.A.F. during the war returned to the company and for the past seven years has been secretary. Mr. Lee was with the company for a brief period before joining the Royal Signals with which he attained the rank of captain. On returning to civilian life he passed both civil and electrical engineering examinations and is at present head of the Design Department of the company.

On 7th May **Sir George Nelson,** Bt., chairman and managing director of the English Electric Co., Ltd., was made an honorary freeman of the Borough of Stafford. In presenting to Sir George a silver casket and scroll at the ceremony held in the Guild Hall, Stafford, Ald. H. H. Coghlan, Mayor of Stafford, said the honour was granted to Sir George in recognition of his interest in the welfare of the town and to mark the completion of his twenty-five years' service as chairman and managing director of the English Electric Co., Ltd.

The Mayor of Stafford presenting to Sir George Nelson, Bt., a silver casket and scroll on his admission as an honorary freeman of the Borough

On Friday last the **Institution of Engineers-In-Charge** held its fifty-first annual dinner at the Connaught Rooms, London, under the chairmanship of the Rt. Hon. Lord Sempill, vice-president of the Institution. After the loyal toast had been proposed by the chairman a toast to the Institution was proposed by Mr. Antony Vickers, who made a humorous but interesting speech about the value of the engineer to the community. He said that technical progress should be

ELECTRICAL WHO'S WHO

The 1956–57 edition of the "Electrical Who's Who" is now available from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1. This edition has been considerably enlarged and contains some 7,000 entries in addition to the index in which names in the biographical section are classified under companies or other organisations. The price remains at 21s (postage 1s 5d)

welcomed by all instead of being resisted as it was at present by some sections of the population. The response was made by Lord Sempill, who said that as a nation we could not afford to neglect the possibilities which automation had to offer. He compared the Russian, American and British technical training facilities and said that we were well behind. Thus, we must take the fullest possible advantage of new ideas and techniques and available scientific manpower.

The toast "Our Guests" was proposed by Sir Harold Roxbee-Cox, who also spoke on the subject of technical training, the response being made by Lt.-Col. S. J. M. Auld. A toast to the chairman was proposed by Mr. W. J. Watkins, chairman of the Institution, and Lord Sempill replied briefly.

OBITUARY

Dr. Oscar Faber, C.B.E., D.C.L. (Hon.), D.Sc., F.C.G.I., M.I.C.E., M.I.Mech.E., M.I.E.E., the well-known consulting engineer, died on 7th May at the age of sixty-nine. Dr. Faber, who was senior partner of Oscar Faber & Partners, was educated at St. Dunstan's, Catford, and the City and Guilds Engineering College. He was an authority on reinforced concrete and steelwork design and heating and air conditioning, on which subjects he had published a number of books, most of which have become standard works. Among his many important consultant works were the new Bank of England, Church House, Westminster, Africa House and the House of Commons reconstruction, for the last mentioned of which he was the principal deviser of the air-conditioning plant and the constructional work. He was a past-president of the Institution of Heating and Ventilating Engineers and of the Institution of Structural Engineers.

Mr. William McGill died at Bexhill on 4th May. In 1913, when practising as a solicitor in Dundee, he was invited by the late Mr. George Balfour, M.P., to join Balfour, Beatty & Co., Ltd., in London as its secretary; he became a director in 1927. Mr. McGill was especially concerned in the large-scale development of electric power in England, Scotland and Wales and played a prominent part in the Parliamentary promotions and the legal problems and agreements involved in the electricity scheme of the Grampian, Midland Counties, Llanelly, Carmarthen Bay, Lancashire, Metropolitan and other electric supply companies with which Balfour, Beatty was associated; he was a director of many of these companies.

He played a leading part in the affairs of the Incorporated Association of Electric Power Companies in London, serving for a period as its president and as chairman on its Legal and Parliamentary Committee. He was also for some time a member of the National Consultative Committee established by the Central Electricity Board, and a member of the Council of the British Electrical Development Association. Mr. McGill resigned from his directorships of Balfour, Beatty and of its parent company, the Power Securities Corporation, Ltd., in 1953 owing to ill-health.

Mr. H. Leslie Bullen died on 10th May at the age of fifty. He had been for the past twenty-two years manager of the Lewisham branch of the Wholesale Electric Co., Ltd., which he joined in 1924 as a stores assistant.

Dr. S. Whitehead.—There was a very large congregation at the funeral service of Dr. S. Whitehead, director of the Electrical Research Association, whose death was reported in our last issue. It was held at the Parish Church, Hampton, Middlesex, on 10th May. The E.R.A. was represented by Mr. Norman Elliott (on behalf of the president, Lord Citrine), Mr. F. H. Bramwell (chairman of Council), Mr. R. A. McMahon (secretary) and many members of the staff. There were also representatives of the electricity supply industry; electrical manufacturers' and allied associations as well as individual companies; research associations; universities and colleges; the D.S.I.R. and Government Departments; and professional institutions, in addition to relatives and personal friends.

WILLS

Mr. E. I. Mavor, joint managing director of Mavor and Coulson, Ltd., and a director of M. & C. Switchgear, Ltd., who died on 6th November, left personal estate in England and Scotland valued at £88,941.

Mr. R. H. A. Deane, M.I.Mech.E., M.I.E.E., formerly for many years stations superintendent to the St. James's and Pall Mall Electric Light Co., Ltd., who died on 28th October, left £3,159 gross (£3,026 net).

Mr. P. R. Stevenson, M.I.E.E., retired electrical engineer, of J. Ross Stevenson and Co., who died on 7th February, left personal estate in England and Scotland valued at £30,975.

Mr. E. L. Histon, a partner in T. G. Usher & Co., electrical contractors, Newcastle, who died on 8th June last, left £3,381 gross (£2,888 net).

Mr. S. G. Marston, former general manager and engineer of the Stockton Corporation Electricity Department, who died on 11th January, left £1,047 gross (£1,005 net).

Sir Hubert S. Houldsworth, Bt., late chairman of the National Coal Board, who died on 1st February last, left £18,208 gross (£18,027 net).

NEXT WEEK'S EVENTS

Tuesday, 22nd May

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. Scottish Centre. Annual general meeting.

Wednesday, 23rd May

LONDON.—School of Hygiene & Tropical Medicine, Keppel Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers, London Section. "The Measurement of the Velocity of Light by Electronic Methods," by Dr. K. Froome.

Wednesday, 23rd May, to Tuesday, 29th May

TORQUAY.—British Electrical Power Convention.

Wednesday, 23rd May, to Thursday, 31st May

LONDON.—Olympia. Production Exhibition and Conference.

Saturday, 26th May

SOUTHAMPTON. — A.S.E.E. Southampton Branch. Visit to C.E.A. Marchwood Power Station.

Appliance Sales of Electricity Boards

The Central Electricity Authority has compiled a return of new domestic appliances sold by Area Electricity Boards in England and Wales for the year ended 31st March last. The return covers the five main domestic appliances, cookers, water heaters, wash boilers, washing machines and refrigerators and gives the figures for each of the four quarters of the year, together with the percentage changes over the corresponding periods of the previous year. It is proposed to issue a similar return each quarter, including the totals for the twelve months to the end of that quarter. During the two years effectively covered the sales of appliances were greatly affected by various governmental Orders relating to hire-purchase sales.

When assessing the figures in the return, it must be remembered that the sales by Area Boards represent approximately the following percentages of the total deliveries of these appliances to the home market during the periods concerned: cookers 80, water heaters 40, wash boilers 50, washing machines 20 and refrigerators 25 per cent.

Quarter Ended	Cookers	Water Heaters	Wash Boilers	Washing Machines	Refrigerators
June, 1955	52,519	50,298	13,627	38,466	16,709
% change over previous year	−17·1	− 7·6	−15·1	+60·5	+27·2
September, 1955	52,516	60,308	13,690	34,953	23,901
% change over previous year	−18·5	+19·9	−16·0	−14·4	+52·1
December, 1955	57,389	33,586	13,695	32,146	8,558
% change over previous year	−19·2	+ 5·5	−12·4	−34·1	+14·5
March, 1956	45,462	31,615	13,176	20,464	3,764
% change over previous year	−18·9	+ 7·6	−14·1	−59·7	−22·7
TOTAL: 1955/6	207,886	175,807	54,188	126,029	52,932
% change over previous year	−18·5	+ 5·9	−14·4	−23·3	+28·5

AUTOMATION

Report by the Department of Scientific and Industrial Research

A REPORT entitled "Automation" was published by H.M. Stationery Office on Wednesday of this week. This has been compiled by the D.S.I.R. as the result of a study by its Intelligence Division, which is responsible for forward thinking on scientific and industrial problems. The object is to put automation in perspective and to give some idea of its probable future impact on industry. It is not written for the technical specialist, but is intended for the wider audience of industrialists, trade unionists and administrators with an informed interest in the subject.

Technical, economic and social aspects of automation are dealt with under chapter headings such as "The Impact on Management," "The Impact on Labour" and "Extent and Rate of Development."

Broadly, the Report concludes that the United Kingdom, dependent on overseas trade, must lead in exploiting the possibilities of automation. It offers a chance of increasing efficiency and reducing costs, of stepping up production and keeping prices down which makes clear that automation is not in itself completely new. There are three rapidly developing independent streams of technical progress which are now tending to merge to provide a new approach to production. These streams are:—Mechanisation, including transfer machines, mechanical handling and assembly; automatic control of machinery and processes; and the use of electronic computers.

Where any of these streams have joined, the near-automatic factories are found, but at present progress towards automation is mainly in the separate streams.

The most powerful brake on the rate of introduction of highly automatic methods is likely to be the shortage of technical and scientific manpower. This is a general problem raised by all scientific and technical development affecting industry. Government plans for increasing the supply of these skilled people have recently been outlined but the report hints that a big effort is needed if the rate of progress is not to be slower than is desirable for our economy. Limitations of capital may also be important and an urgent need is for comparative information on the capital and running costs of automatic and conventional equipment.

It will be necessary to fuse managerial and technological "know-how" and new types of managers and technicians will be required. Qualities like versatility, adaptability and capacity for understanding other viewpoints will be highly valued and co-operation between everyone in a factory will become even more vital. The effect on labour employment is considered at some length. It depends primarily on the speed of development, and this is not likely to be too rapid if only because of the shortage of technicians and scientists. Changes can raise serious problems for the individual and various methods for overcoming the difficulty are being sought. Training is of particular importance if people are to be able to change their skills in the middle of their careers. Much was learnt about this during the war, when new skills were developed in people both in the military and industrial spheres.

The Report concludes with a useful explanatory note on analogue and digital computers, details of some costing and operational studies of automatic equipment already in use, a survey of training courses which have been held during the past year relevant to automation and an extremely comprehensive bibliography.

The Report is published by H.M. Stationery Office, price 6s.

A.S.E.E. CONFERENCE

SPEAKING last Saturday at the annual conference of the Association of Supervising Electrical Engineers, Mr. R. F. Mathieson, the national president, said that the past year had seen a steady growth in membership and an ever-increasing recognition of the Association's value to the electrical industry. The year had also been a happy one for industry in general and the electrical industry in particular, since the prosperity and expansion of recent years had been maintained. There was every reason to believe that steady progress would continue so long as the economic system was wisely managed to permit of continued expansion.

By adopting the latest production techniques with wisdom and foresight, industry had built a mechanism of production which was capable of supplying our every want in abundance. But although industry was prepared to meet the challenge of the age there had been warnings in recent months that any further advance in our living standards was threatened by yet another economic crisis. We could choose between the continually rising prices of 1956 or the continually rising unemployment of 1926, and in the present atmosphere of industrial relations there was little prospect for a policy of restraint. There was the alternative of a policy of restriction and rationing and there were many who favoured such a policy in more or less degree. There was growing interference by Government in the operation of industry, about which the chairman of the B.E.A.M.A. recently had good cause to complain. The economic problem of to-day was neither unique nor new. The men of industry had a right to insist that a twentieth century production mechanism should not be halted or hampered by the limitation of a nineteenth century economic system. But if we did design an economic system to match modern productive possibilities, much would still remain to be done in the field of human relations before we could enjoy the full benefits of the machine we had created.

Whilst the legislature could and should solve the economic aspect of the problem, industry must tackle the human aspect. More active consultation between master and man could prevent a great deal of industrial strife.

Mr. Mathieson believed that the A.S.E.E. could play a really important part in considering this vast problem and in initiating discussions which could point the way to a new conception of social co-operation in industry.

Turbo-Alternator Standards

BRITISH Standards for steam turbines and for turbine-type electrical generators have been established for many years, but until recently there has not been a standard to co-ordinate sizes of turbines and turbine-type generators and to indicate the preferred MW ratings. The newly published B.S. 2730: 1956 specifies preferred ratings for condensing steam turbo-generator sets over a range from 10 to 120 MW. For the first part of the range, namely, 10 to 30 MW, air-cooled generators are specified, while from 60 to 120 MW hydrogen-cooled generators are covered. The standard is divided into two parts, the first dealing with steam turbines and the second with turbine-type generators. The principle characteristics are quoted for both the turbines and the generators and an appendix deals with the determination of nominal exciter response. Copies of the standard are obtainable from the British Standards Institution, 2, Park Street, W.1, price 3s.

Trade Union Policy

Wages and Working Conditions Discussed at E.T.U. Conference

FROM AN INDUSTRIAL CORRESPONDENT

IN his presidential address Mr. Frank Foulkes told the delegates to the tenth annual conference of the Electrical Trades Union at Hastings last Monday that while profits continued to increase the fight for more wages and higher living standards must be pursued even more vigorously and the Executive Council would be in the forefront in agitating for immediate wage increases in all the industries in which its members were employed. Mr. Foulkes stated that last year 382 engineering firms made profits of £208·6 million, an increase over the previous year of £23·8 million, and 115 electrical and radio firms increased their profits by £11·8 million, to £107·8 million. These figures, he said, were typical of the rise in industrial profits generally and fully justified immediate applications for very substantial increases in the wages of the workers who had created the profits.

Automation and Redundancy

In a reference to automation, Mr. Foulkes said no one would advocate a strike against new methods of production to ease the burden of labour. The Standard Motor strike was against unemployment. It was a demand by the workers, a declaration of the principle of the right to work. They had fought a battle that would have to be repeated throughout the country when redundancy was declared and automation introduced without negotiations and without agreement being reached on wages and conditions under the new manufacturing process. Broad principles for the purpose of establishing negotiating machinery could be decided by national negotiation, but each factory would have to undertake its own responsibilities in the light of developments in the particular factory. "We are in favour of increased production provided the workers are going to participate in the benefits," he said.

Mr. Foulkes said he was convinced that the visit of the Soviet leaders to this country must lead to a better understanding between the Governments of the two countries. The exchange of delegations of technicians led by Mr. Malenkov and Lord Citrine could be of inestimable value to the electricity supply industries of both countries. An atmosphere had been created that could lead to the realisation of each other's aspirations and the overcoming of many difficulties. Friendly contacts had been established that could lead to agreement to ensure a future of peaceful security.

Concluding, Mr. Foulkes said, "We should be proud of the progress we have made in nuclear power research, and the contributions our scientists made on this subject at the international conference at Geneva. But there are tremendous possibilities for increased developments by the transfer of capital and scientific knowledge from armaments to the industrial potential, and the ambitious plan of twelve nuclear power stations to be built by 1965, with more rapid expansion until 1957, can only be guaranteed if capital is made available."

It was noon when the conference was able to get down to its agenda, after the Mayor's welcome and the annual presentation of the Union's gold badges for long and meritorious service.

One of the first resolutions, sponsored by Manchester, urged the Executive Council "to press, by all available means, for the introduction of legislation to provide adequate safeguards for the protection of all workers employed in atomic power stations." Mr. L. J. Gregory, for the Executive Council, agreed that more research was needed into the problem of safety and protection.

Swansea wanted the Executive Council to formulate wage claims that would keep craft earnings in line with the earnings of production workers. Mr. T. Vetterlein explained that accurate detailed information on individual earnings was hard to obtain but said that the Executive Council supported the spirit behind the motion, which was adopted.

A demand that the aircraft industry should be nationalised met with unanimous approval.

The "hardy annual" of the national rate came up this year in a transparent guise. A composite motion expressed the opinion that the policy of the Union should be "to obtain a national rate in each industry in which our members are employed." The mover said it cost just as much to live in the country and they did not want two persons doing the same job at different rates of pay.

Mr. F. L. Haxell, general secretary, said the Executive Council's policy had been based largely on the assumption that rents and fares were higher in London than elsewhere. The Council, however, now held the view that little was to be gained from the policy of maintaining a differential for London. But it was realised that the employers would not be willing to equalise rates on the basis of the highest rate.

A composite motion was formally moved and carried which asked the Executive Council to do all in its power to secure a sick pay scheme for the electrical contracting industry. The Executive was also asked to give urgent consideration to pressing the N.F.E.A. to agree to an increase in the adult mate's rate from 75 per cent to 80 per cent of the journeyman's in areas outside London and Bristol.

A resolution on behalf of manual workers in the supply industry sought conditions at least on a parity with those of the clerical and administrative grades in relation to sick pay, holidays and superannuation. Mr. J. Humphreys, of the Executive Council, pointed out that the problem was not specific to the supply industry.

On Tuesday the delegates approved an Executive Council resolution insisting that "automation with its resulting increased productivity and increased profits must be accompanied by increased wages." Only six voted against the resolution which also called for negotiations at all stages and all levels; where redundancy took place the payment of full wages until alternative employment was found; a shorter working week without loss of pay; and an increase in annual holidays to a minimum of three weeks.

Technological Awards

DETAILS of the awards to be given by the recently created National Council for Technological Awards, under the chairmanship of Lord Hives, are announced. The National Council will grant a diploma in technology, the courses for which will be equivalent in standard to honours degree courses of a British university.

The awards will be denoted by "Dip.Tech.(Eng.)" for engineering and by "Dip.Tech." for other technologies. There will be two honours classes, first-class and second-class, the intention being that a student who successfully completes the course will normally reach the level of second-class honours. Those who do not reach this standard may be considered for award of the diploma at the passed level.

The courses which will be recognised in connection with the awards may be either full-time or sandwich courses. The minimum time required for academic studies in a technical college must not be less than three years full-time or four years sandwiched. Colleges seeking recognition for a course must make formal application to the Council.

INDUSTRIAL NEWS

Electricity Generation in Industry

In the current issue of the "Monthly Digest of Statistics" (H.M. Stationery Office, 4s 6d) a new table is included for the first time showing production of electricity by industry in addition to that produced for public supply. It is intended to release the latest figures in the monthly statistical statement on electricity in future; the figures for 1955, with those for April last and the corresponding figures for April, 1955, are given in the accompanying table.

Industry	Electricity Generated (million kWh)		
	1955	4 weeks ended 28.4.56	4 weeks ended 30.4.55
Chemicals ...	2,658	210·6	191·6
Iron and Steel ...	2,151	169·1	167·5
Engineering ...	1,245	95·9	96·8
Textiles, etc. ...	647	48·3	47·9
Food, etc.... ...	278	17·5	17·1
Paper	1,934	150·4	143·7
Other industries...	480	30·3	37·4
Total	9,393	722·1	702·0

The monthly figures do not include certain producers of electricity for which only annual statistics are available. These are as follows, with the 1954 figures in parentheses:—Railways and transport undertakings (1,332 million kWh); coal mines (1,659 million kWh); gas works (108 million kWh); and petroleum refineries (172 million kWh).

Nickel Import Duty Exemption

The Treasury have made an Order which continues for a further period of one year from 13th May the exemption from duty under the Import Duties Act, 1932, of certain forms of nickel and ferro-nickel alloys imported in the forms described in the Schedule to the Import Duties (Exemptions) (No. 3) Order, 1955 (S.I. No. 676).

B.E.P.C. Exhibition

Since our preview of the exhibition at the British Electrical Power Convention went to press we have heard from the Metropolitan-Vickers Electrical Co., Ltd., that it is withdrawing its display of "Redring" boiling plates. In its place the company is showing a scale model of a gas-turbine-electric locomotive which it is supplying to the Western Region of British Railways. This is rated at 3,000 h.p. at the turbine coupling and 2,450 h.p. at the wheels. It has a maximum tractive effort of 60,000 lb, a speed of 90 m.p.h. and a weight of 130 tons.

Thorn Electrical Industries, Ltd., are showing a varied display of "Atlas" products, including the "Kitchenlite," one of the first fluorescent fittings designed essentially for domestic use; it is a 4ft 40 W tube. There will also be a display of "Forrest Modern Glassware" lighting fittings and street-lighting lanterns.

Batteries and equipment for electric vehicles are being shown by Chloride Batteries, Ltd. A Krieger brougham (*circa* 1900) will tour the streets of Torquay during the Convention.

Standard Capacitors

Continuing the "Notes on Applied Science" series, the National Physical Laboratory has just issued No. 13, "Standard Capacitors and their Accuracy in Practice" (H.M. Stationery Office, 1s 3d net). Primarily the booklet is concerned with capacitors designed for use as laboratory standards of capacitance. Its purpose is to draw attention to the various factors which affect the performance of capacitors by virtue of their construction and method of use.

Air dielectric and solid dielectric capacitors are discussed and there are sections on the inductance and resistance of capacitors and the effects of leads to the measured values. Good quality capacitors, whether with air or mica dielectrics, provide standards of reactance not greatly inferior to that of a good resistor, provided that proper precautions are taken in their maintenance and use. Clamped mica capacitors of between 0·1 μF and 1 μF are probably the most stable.

Chemical Production in Australia

For many years the d.c. supplies for the electrolytic production of caustic soda and potassium chloride at the Yarraville factory of Imperial Chemical Industries in Melbourne, Australia, were provided by three 500 kW rotary convertors. As these machines approached the end of their useful life, with a consequent rise in maintenance expenses, it was decided to replace them with mercury arc rectifiers and to take the opportunity at the same time of increasing the capacity of the plant. Three 870 kW steel-tank rectifier equipments were ordered from the General Electric Co., Ltd., and the rotary convertors were replaced one by one, so that production was not interrupted during the change-over.

Electric Road Transport

The May issue of "Public Transport," issued by the British Electrical and Allied Manufacturers' Association, refers to next week's British Electrical Power Convention, with its "Electricity and Transport" theme, and to the Passenger Transport Association's annual congress held at Scarborough this week. It is recalled that at last year's P.T.A. Congress the general manager of the Midland Motor Omnibus Co. suggested that operators should be prepared for "a return to electric operation at some future date when the C.E.A.'s plans for expansion of generating resources and the use of nuclear power come to fruition." News of electric traction development includes an article on the reasons for the use of trolley-buses by the general manager of the Auckland (N.Z.) Transport Board.

Fire at Cabinet Works

A fire occurred on 11th May at the cabinet works at Rayleigh, Essex, of H. Hermann, Ltd., a subsidiary of Thorn Electrical Industries, Ltd. The factory consists of five separate buildings, one of which, an 18,000ft structure built last year, was completely gutted. Clearance of the fire site has already begun in preparation for rebuilding and arrangements have also been made to erect a temporary building nearby which is expected to be ready for occupation in July. In the meantime alternative facilities have been arranged and production of radio and television cabinets will not be interrupted.

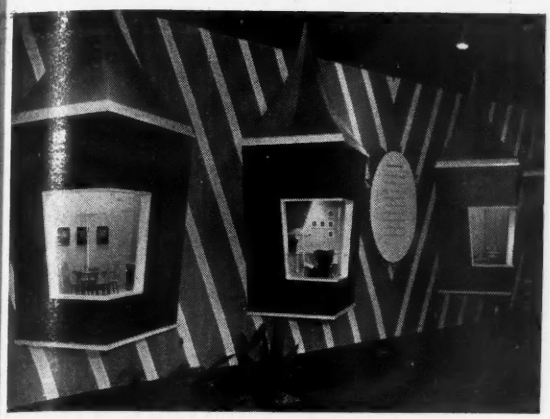
Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £189 0s 0d
COPPER, H.C. Electro	ton £351 10s 0d
Fire Refined 99·70%	ton £350 0s 0d
Fire Refined 99·50%	ton £349 0s 0d
COPPER Tubes ..	lb 3s 4½d
Sheet	ton £426 15s 0d
H.C. wire and strip ..	ton £390 15s 0d
LEAD, English ..	ton £110 15s 0d
Foreign	ton £109 0s 0d
MERCURY	flask £85 0s 0d
TIN, block (English) ..	ton £751 0s 0d
ZINC, G.O.B. Foreign	ton £94 10s 0d
Electrolytic	ton —
BRASS TUBES (solid drawn)	lb 2s 8½d
Sheet	ton £334 0s 0d
Wire	lb 3s 4½d
PHOSPHOR BRONZE Wire	lb 4s 11½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 25⅝d—25⅞d

Industrial Safety Training Centre

Some five years ago the Birmingham and District Industrial Safety Group established the first Industrial Safety Training Centre in this country. It was in the main directed against accidents on power-presses. With the co-operation of manufacturers of presses, manufacturers of guards and member firms of the group, a collection of up-to-date machinery was acquired and the services of first-class lecturers and demonstrators obtained. The



Model interiors demonstrating recipes for "lighting to measure" at the A.E.I. Lamp and Lighting Co.'s "Spring Show"

increasing use made of the Centre made it necessary to acquire new premises at Summer Road, Acocks Green, Birmingham, 27, which have now been adapted as the first permanent Industrial Safety Training Centre in the United Kingdom, and these were officially opened by the Minister of Labour and National Service on 12th April. An "open day" was held on 9th May.

The proceedings opened with an informal inspection of the premises and the equipment. At a luncheon Mr. C. D. Lovell, works director of Alfred Bird & Sons, Ltd., and chairman of the group, gave a brief talk on the future of the Training Centre and the part which it could play in reducing accidents in industrial establishments. He mentioned that it had been possible to include new courses in the syllabus dealing with electrical installation and maintenance; the operation of industrial trucks and fork lift trucks; crane-driving and slinging; the use and maintenance of lifting machines; and, in addition, a special course for foremen and supervisors. After lunch practical demonstrations were given on the construction and operation of power-presses and the use of lifting appliances. A syllabus of courses has been prepared and is now available on application from the manager of the Centre. The chairman of the Training Centre is Mr. R. Bramley-Harker, Deputy Chief Inspector of Factories.

Lamps and Lighting Exhibition

An exhibition of lamps and commercial and industrial fittings was opened to the public at the Mazda showroom, Crown House, Aldwych, London, W.C.2, by the A.E.I. Lamp & Lighting Co., Ltd., on 8th May. The exhibition includes a selected range of tungsten and fluorescent industrial and commercial lighting fittings for the first time. New fittings in the commercial range include a totally enclosed 5ft fluorescent fitting with a reeded "Perspex" cover and a number of open or closed opal glass filament lighting fittings for rod or chain suspension or direct ceiling mounting, including new "Brandy Glass," "Acorn" and "Mushroom" designs.

New fittings in the industrial range which are shown include bulkhead and well-glass fittings and a general purpose "Gripper" handlamp. The recently announced fluorescent vitreous enamel overlamp reflector fitting and the new Mazda "Monolux," a 5ft fluorescent fitting packaged complete with lamp, are on view. Lamps for industrial, commercial, decorative and domestic use are shown and the correct use of lamps in the house is demonstrated by "lighting-to-measure" wall display units which not only give recipes for general lighting but also simple directions for the correct placing of table and standard lamps for comfortable reading, writing and sewing.

Wholesalers' New Premises

Formerly with offices at Victoria and stores at Westminster, the London electrical wholesalers, Halsey's Electric Co., Ltd., have now moved into their new premises at Brandon House, Wyfold Road, Fulham, S.W.6. As can be seen from the accompanying picture the building is in two parts, both of which are internally connected, consisting of a four-storied reconstructed warehouse on the left and the newly erected block on the right which houses the reception and executive offices, general offices, staff canteen, etc. Altogether there is over 30,000 sq ft of store and office space, and a large goods lift serves the four well stocked floors of electrical goods and accessories. In addition to a roomy trade counter there is also a loading bay where five of the company's vans can be loaded at one time, allowing easy transfer of goods from the packing department to the vehicle. There are in all twelve vans, all of which serve the London area.

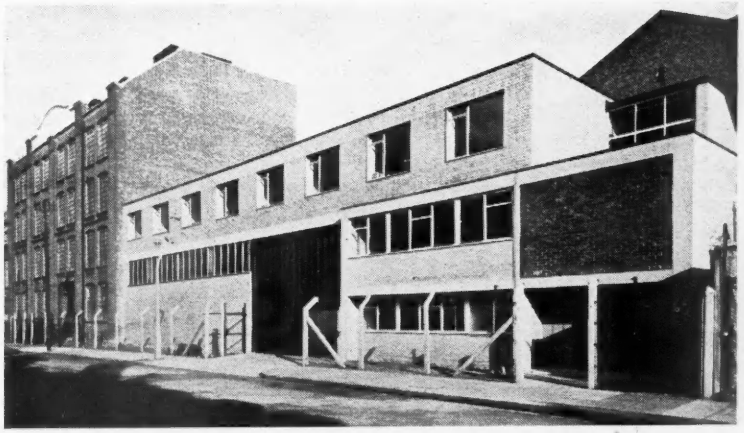
Damages Against Boards

In the High Court on 10th May Mr. Justice Barry awarded £16,900 damages and costs to Mr. Alfred N. Maurice (32), of West Norwood, against the London Electricity Board and the North Thames Gas Board. It was stated for Mr. Maurice that he was seriously injured when an explosion occurred in a street manhole in London as he was passing it in October, 1953. As a result he would be confined to a wheel-chair for the rest of his life. The two Boards admitted liability and had paid £16,000 into court.

St. Lawrence Cable Order

The 230 kV cable contract for the Ontario Hydro power house of the St. Lawrence power project has been awarded to the Phillips Electrical Co., Ltd., the Canadian affiliate of British Insulated Callender's Cables, Ltd. The contract for the manufacture of the cable, valued at approximately $250,000, has been placed with B.I.C.C. Four circuits are planned with a total length of 20,000ft using a cable 3·53in in diameter. An oil-filled cable with a hollow copper core 960 mcm in area has been selected for the purpose. The cable, which will be manufactured in the B.I.C.C. Erith Works, will have a special fire-proofed, anti-corrosion protective covering on the outside.

For the Canadian half of the project the installed capacity at the Robert H. Saunders - St. Lawrence generating station will be 820 MW. Four banks of transformers at the station will step up the power for transmission through the cable. The 230 kV cables terminate at a structure some 600ft from the power house. Thence the power is to be carried by four single-



The new Fulham headquarters of Halsey's Electric Co., Ltd.

circuit overhead transmission lines to the St. Lawrence transformer station, 2¼ miles north of the power house, to be fed into the Southern Ontario system of the Hydro-Electric Power Commission of Ontario.

It is expected that the first cables will be installed early in 1958 and the job completed late in 1959. Installation will be carried out by the Phillips Electrical Co.

British Transformers for California

The Department of Water and Power of the City of Los Angeles has awarded a contract to the English Electric Export Trading Co., Ltd., for two 3-phase 18/140 kV 60 c/s 200 MVA power transformers together with spare parts. The contract is valued at approximately $500,000.

The transformers will be installed at the Scattergood steam plant, California, and will be of the forced-oil-cooled, oil-immersed, outdoor type. This equipment will be designed and manufactured at the English Electric Company's Stafford Works.

Transistors for Telephone Service

The South African Post Office has recently placed a substantial order with Standard Telephones & Cables, Ltd., for three-channel open wire carrier systems making use of hermetically sealed junction type transistors throughout the terminal equipment. As a result of this the power consumption is reduced to approximately $\frac{1}{10}$ compared with a conventional valve operated system and the reliability is improved. The use of transistors also reduces the heat dissipation and the small size enables a more compact mechanical layout to be achieved.

These carrier systems are designed to provide either three high-quality telephone channels; or two high-quality telephone channels, one narrow-band telephone channel, and six duplex telegraph channels on an open-wire pair, making use of the frequency band 6-31·5 kc/s.

Hurseal "At Home"

The directors and executives of the Hurseal group of heating companies (Hurseal, Ltd., Gulf Radiators, Ltd., and Sealdraught, Ltd.) are to hold an "At Home" at the Building Centre, 26, Fore Street, London, W.1, on 7th June. Prize-winning designs of the Institute of Fuel's recent open competition, which show a new concept in the approach to the open fire, will be exhibited together with a number of new radiators and redesigned products of the Hurseal heating group.

The "Empress of England"

Electrical equipment to the value of about £62,000 is being supplied by the General Electric Co., Ltd., for the Canadian Pacific Railway Co.'s new liner, *Empress of England,* which was launched at Vickers - Armstrongs Naval Yard, Walker-on-Tyne, on Wednesday last week. The naming ceremony was performed by Lady Eden and the new ship is due to go into service early in 1957.

The equipment the G.E.C. is supplying includes a lighting installation comprising over two miles of "Osram" cold cathode ivory and gold fluorescent tubing and a wide variety of tungsten lighting fittings for lighting all first and tourist class public rooms. Other equipment to be installed in the new liner includes a complete luminous call system, and a fire alarm system consisting of a bridge indicator and 50 fire alarm points throughout the ship.

Simplified Control Gear

The American company known as Square D has lately set up an associated company in this country, Square D, Ltd., for the manufacture of electrical control gear, and we recently paid a visit to their London premises at 100, Aldersgate Street, London, E.C.1, where the company has its head office and a central warehouse. Manufacturing is carried out at Swindon. Emphasis is placed very strongly in its products on standardisation and interchangeability: a works electrician can modify gear for different voltages, contact arrangements, duties, etc., by ordering the appropriate modification kit which has every item required in connection with the change. Coils are moulded into solid material and are interchanged merely with the use of a screwdriver. The manufacture of multiple control panels from standard equipment to order is also undertaken.

Trade Announcement

Marconi Instruments, Ltd., informs us that its business in London and the south will in future be dealt with at Marconi House, Strand, London, W.C.2, where the company recently opened a permanent showroom. It has decided to terminate the limited reselling facilities which have been in operation hitherto and in future Marconi instruments will only be obtainable in this country direct from the company. The export business of the company hitherto conducted by the Instrumentation Export Division at Marconi House has been transferred to the head office of Marconi Instruments, Ltd., at Long Acres, St. Albans.

Switchgear Company's Jubilee

The Donovan Electrical Co., Ltd., Birmingham, celebrates its fiftieth anniversary this year and to commemorate this jubilee, a dinner was given to employees on Friday last at the Grand Hotel, Birmingham.

The firm of Donovan & Co. was founded in 1906 by Mr. G. O. Donovan (now retired) with three employees, one of whom, Mr. H. Bosworth, is still with the company. In 1910 the present chairman, Mr. Walter Donovan, joined the firm as partner. For the first twenty years of its existence the company's manufactures were confined to manually operated starters and switch and fusegear, and up to 1920 the business was conducted from Cornwall Street, Birmingham. With the extension of its manufactures to include automatic control gear it was necessary in 1927 to build, in addition, new works at Stechford, where extensions have since been made from time to time. In 1932 the Birmingham office and Wholesale Department were transferred to larger premises on the corner of Great Charles Street and Newmarket Street. These premises were destroyed in 1940 by enemy action and after temporary accommodation, the present Granville Street offices were purchased in 1947.

The company became a private limited company in 1933 when its present title was adopted, and Mr. G. O. Donovan and Mr. W. Donovan were joined on the board by two of the present directors, Mr. E. T. G. Donovan, Mr. J. W. Donovan and the late Mr. H. Varnom. A further member of the family, Mr. G. W. Donovan, joined the board in 1939 and in this jubilee year of the company, Mr. F. N. Dalman, the company's chief engineer, has been appointed a technical director.

Since the war the company has designed automatic gear to control increasingly complex processes and machines, and a number of novel and outstanding schemes for automation have been provided by it. There are now 350 employees.

At the dinner last Friday, Mr. Walter Donovan presided and guests included Mr. George Donovan, the founder. During the evening presentations of inscribed gold watches were made to four new members of the "21 Year Group," and a cheque for £100 was presented to Mr. Bosworth, who has completed fifty years with the company. The recipients were introduced by Mr. E. T. G. Donovan and the presentations were made by the chairman.

Mr. J. Goy, the chief draughtsman, proposed the toast of the company, and said that its present size was indicative of its strength and progress. Mr. W. Donovan, in responding and welcoming the guests, spoke of the early days of the company and of the men who had helped to establish it.

Mr. A. E. Edwards (Stechford Works) replied on behalf of the guests and said that the building up of the company has been a family effort. Mr. R. H. Varnom wished the company success in its "second lap," and thanked Mr. Graham Donovan for the excellent evening's arrangements.

ARCTIC IRON

3.—WORLD'S LARGEST ELECTRIC PIG-IRON FURNACES

Close to one of the 5ft diameter electrodes when the furnace is operating

OUR previous two articles have described broadly the new Mo i Rana iron and steel works of A/S Norsk Jernverk and the comprehensive arrangements which have been made for power supply. This week we give an account of the construction and operation of the 20 MW pig-iron furnaces themselves. These were manufactured by Elektrokemisk A/S of Oslo and represent about 60 per cent of the maximum load of the works, their use representing overall a very large capital investment.

Electric iron smelting offers obvious advantages in a country like Norway. The only coal resources are in Spitzbergen, isolated in the Arctic and producing at present about 400,000 tons annually of good coal. Otherwise coal or coke has to be imported from other countries. Hydro-electric power on the other hand is cheap and abundant, many undeveloped sites still being available.

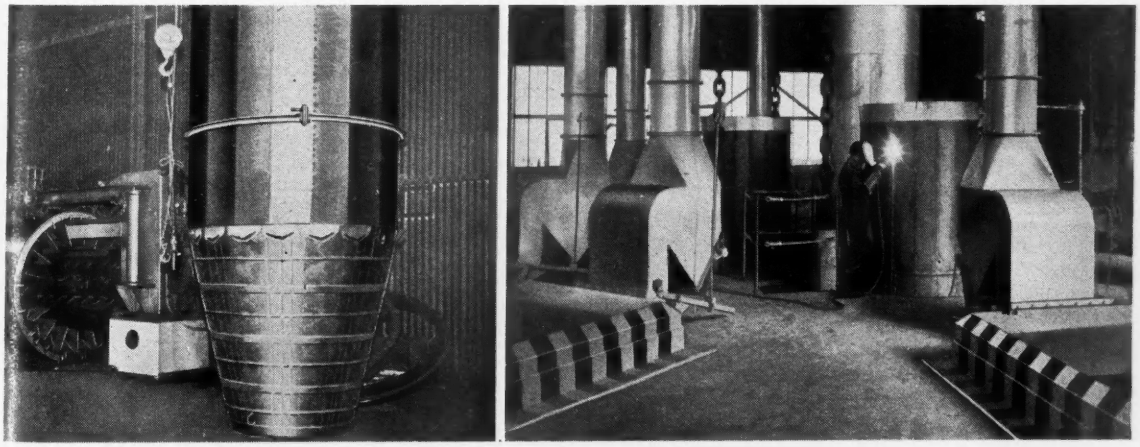
Although the heat required for smelting is provided electrically, coke is still needed to reduce the iron ore to iron with consequent generation of carbon monoxide. About 900 lb of coke is used in the production of a ton of pig iron, and about 2,250 kWh of power. Much of the coke required is expected to be bought from England, although future plans envisage the setting up of coke ovens at Mo i Rana, producing coke from Spitzbergen coal.

Most types of coke can be used although it is important that they should react readily in contact with the ores. Metallurgical coke is not essential, cheaper lump coke and coke breeze being bought, crushed if necessary, dried and graded for use in the iron furnaces in sizes of $\frac{1}{2}$in to 2in, and $\frac{1}{8}$in to $\frac{1}{2}$in. Gradings less than $\frac{1}{8}$in are ground further and used for sintering the iron ores.

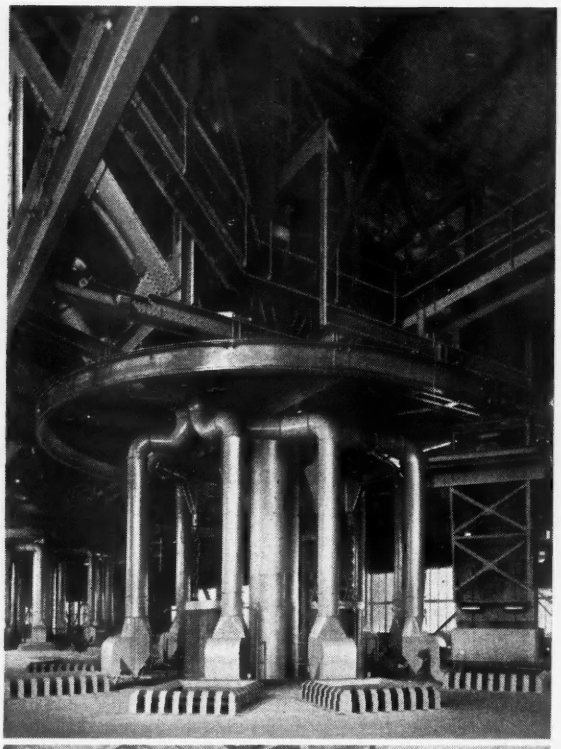
Since the coke plays a large part in allowing the passage of heavy currents through the furnace it is essential for it to be evenly distributed throughout the charge and a succession of layers of different materials, as in the conventional blast furnace, would not be feasible.

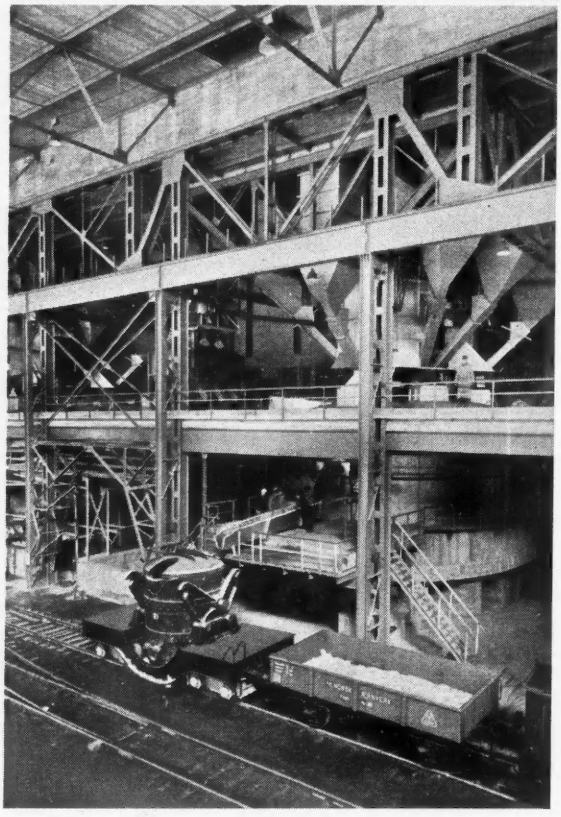
The automatic weighing and batching plant was described in our first article. The prepared mixture is grabbed and hoisted to the upper floor of the furnace house by the telpher operator, whose cab can just be seen in the top left-hand picture on page 842. His vehicle runs on a monorail system enabling him to serve any bin of two furnaces. Each furnace has nine bins from which the materials feed by gravity chutes to six entry ports on the furnace roof. The chutes are kept full, the materials feeding continually into the furnace as smelting continues. A dust removal system is coupled to the top of each bin, fans and cyclones keeping dust to a reasonable level. The cyclones and ducting to each bin can be seen in the illustration below.

The reduced amounts of coke used compared with a blast

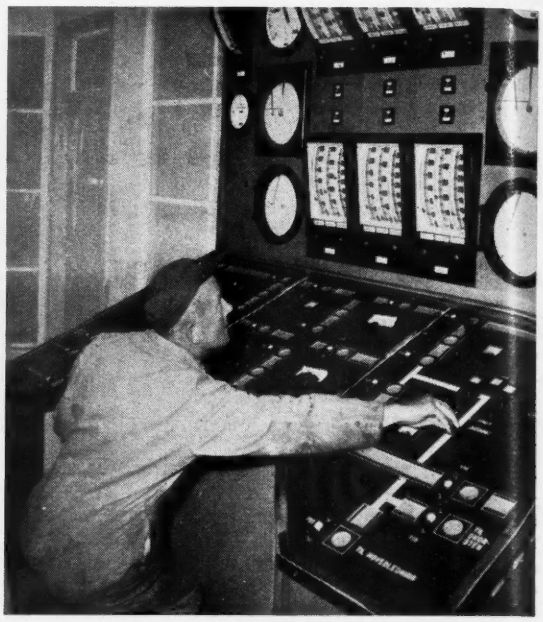


In the electrode casing shop, and (right) a new section being welded into position





An iron furnace as a whole. The feed chutes are clearly seen. The charging floor is shown in the top picture with the telpher just about to unload into the top of a feed hopper on the right. The large central tube is for gas



Gas distribution control panel

furnace, means that sulphur and phosphorus impurities are fewer and a high quality pig iron is produced enabling the acid Bessemer process to be used for steel production.

Most of the coke is converted into carbon monoxide which is taken off from the top of the furnace through the large steel tube which can be seen in the centre on the photograph of the upper floor. Gas production amounts to about 19,000 cu ft per ton of iron produced, the calorific value being about 280 B.Th.U. per cu ft corresponding to a gas of 85 per cent pure carbon monoxide.

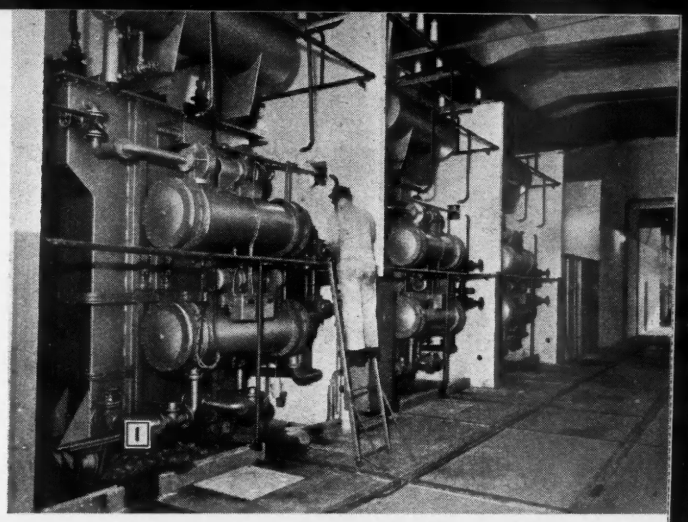
An extensive gas cleaning system is installed using Buffalo Forge scrubbers, provision being made for each two furnaces on a common system employing six scrubbers, two being in reserve. A gas control panel is installed in the furnace control room (one for two furnaces) and controls gas distribution via motorised valves. The works has an extensive gas system and a gasholder to cater for surpluses over the constant demand for heating in buildings, soaking pits, etc. If necessary gas can be discharged directly to the atmosphere above each furnace, being burnt on emission.

The furnace itself consists of a steel pot about 40ft in diameter and 16ft high, lined with chamotte and chrome magnesite refractories. The roof is of chamotte partly supported by water cooled steel beams and the hearth is of monolithic tar dolomite.

Electric power is fed into the furnace via three continuous Soderberg electrodes, each almost 5ft in diameter and operating at a maximum current density of about 32 A/sq in or 90,000 A per electrode.

The electrodes consist physically of sheet steel cylinders, with a tapered bottom section. These are filled with a patent carbon paste preparation supplied to the works in blocks which are melted down and poured into the casing at the upper floor level. Here also further lengths of steel container are welded on as necessary. This can be seen in process in one of our illustrations. About 20 lb of carbon paste is consumed per ton of pig iron produced.

To fabricate the steel electrode casings a small shop is provided in the iron plant. Casings are resistance welded from 18 gauge sheet metal, reinforced by internal ribs



1. Transformer bay. All are 11,000 kVA single-phase units. 2. Bank of condensers for use on one furnace 3. Busbars leading from the transformers, which are beyond the wall on the right, to the furnace. Behind can be seen the control room for one pair of furnaces

which serve not only for mechanical strengthening of the holder but also prevent the baked carbon paste from breaking up under the high temperature conditions of the furnace, and ensure a more even distribution of current throughout the diameter of the electrode. A steel casing section in position on the resistance welding machine, and a new electrode casing in the electrode shop, are illustrated.

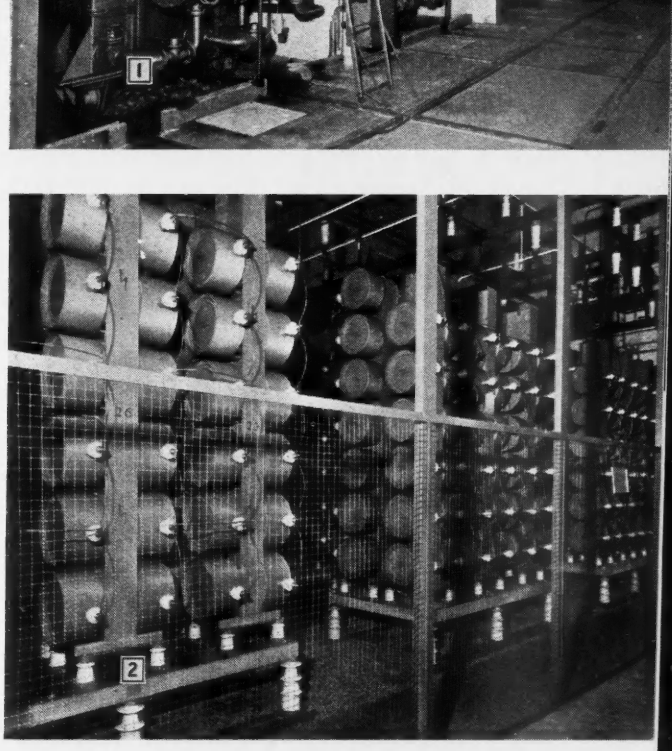
These electrodes are each suspended on two chains from a winch on the upper floor, their position being automatically controlled, as described later, from considerations of current and voltage at any moment.

The busbars feeding the electrodes are coupled by cables to a water manifold pipe from which many pipe connections feed down to the heavy iron clamping ring which is best seen in our title picture. This ring is watercooled and supplies current into the mass of the electrode, being fed in its turn by current flow in the water pipes themselves which thus perform a dual function.

Very large quantities of water are used for this purpose and for other miscellaneous uses in the ironworks, which takes well over half of the water used in the whole plant, with a maximum demand of about 46 cu ft/sec. Special arrangements had to be made for the supply of water to the plant, involving the damming of a suitable stream and construction of a small tunnel 2½ miles long.

Running the length of the iron works, on the main operating floor and behind the furnace control rooms are the transformer bays, condenser rooms and 20 kV switchgear. A concrete wall divides this area from the furnace operating area.

A main 20 kV breaker is provided for each furnace, supplied direct from Svabo, the main substation, by three 0.23 sq in cables per phase and the basic circuit arrangements are shown in the accompanying diagram.



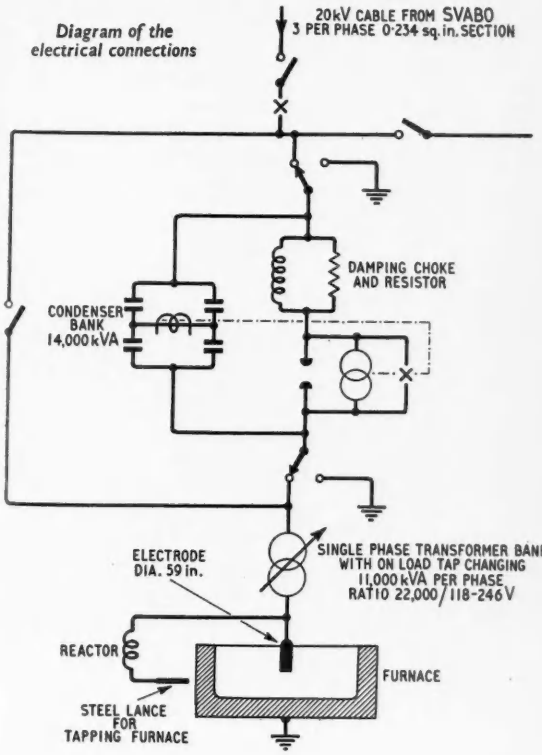
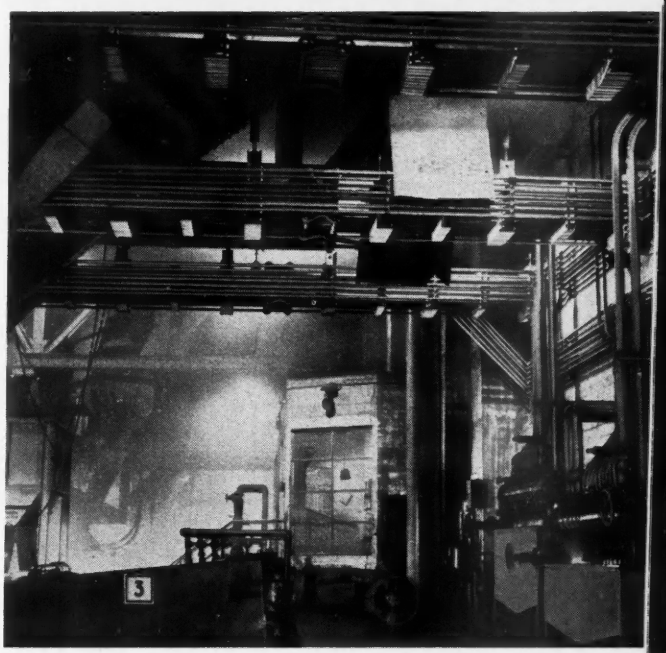
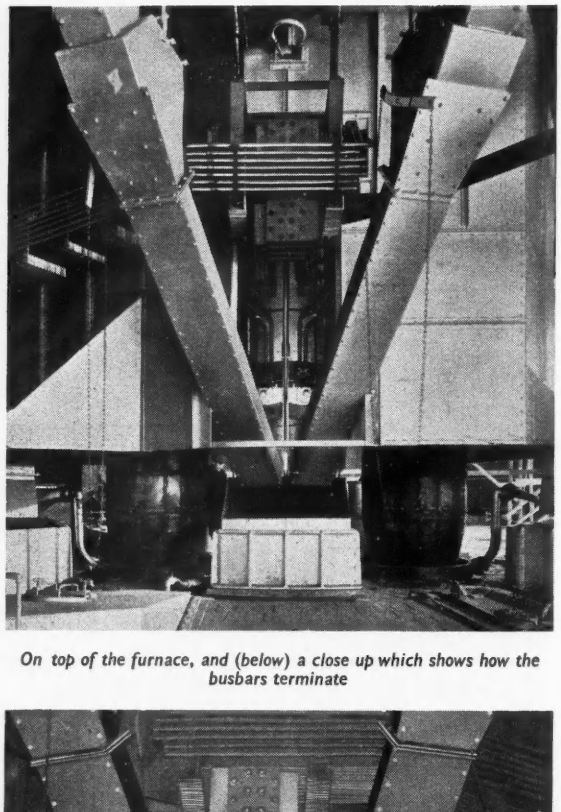

20kV CABLE FROM SVABO
3 PER PHASE 0·234 sq. in. SECTION
DAMPING CHOKE AND RESISTOR
CONDENSER BANK 14,000 kVA
ELECTRODE DIA. 59 in.
SINGLE PHASE TRANSFORMER BANK WITH ON LOAD TAP CHANGING 11,000 kVA PER PHASE RATIO 22,000/118-246 V
REACTOR
FURNACE
STEEL LANCE FOR TAPPING FURNACE

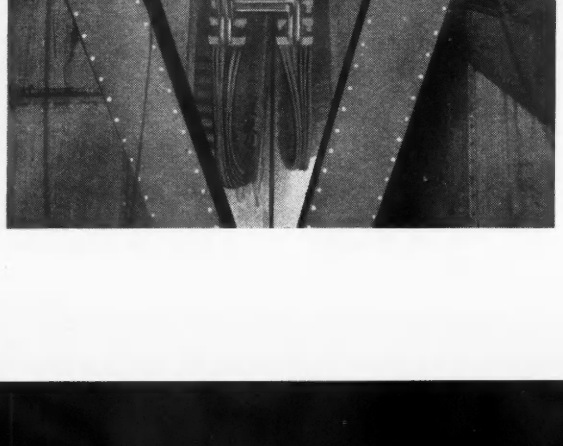
Diagram of the electrical connections



The furnace roof during construction



On top of the furnace, and (below) a close up which shows how the busbars terminate



This type of furnace has a comparatively high inductive reactance due to the high currents and the wide spacing of the electrodes. To correct this, static capacitors are inserted in series with the h.v. side of the furnace transformer resulting in an overall power factor on the furnace supply of about 0.95 lagging.

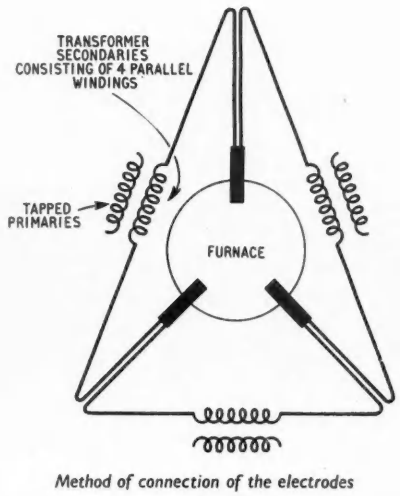
The furnace transformers are single-phase units each of 11,000 kVA rating, stepping down from 22 kV to a secondary voltage variable between 120 and 245 V. Secondary voltage variation is achieved by on-load tap changing over 25 steps on the primary side and by switching the connections of the three-phase bank from star to delta. Starting up of the furnace is done using the star connection, this giving the lower secondary voltage and limiting the initial current surges. Transformer cooling is by forced oil circulation through water coolers, and the manufacturers were A/S National Industri of Drammen. All are covered by " Mulsifyre " protection.

Per phase 4,680 kVAr of capacitors have been installed: the physical magnitude of a three-phase bank is indicated by the illustration. The voltage across each bank is $22/\sqrt{3}$ kV and the total current under these conditions 369 A. The capacity of each bank is about 93 μF, made up of 156 elements connected in thirteen parallel groups each group having twelve elements in series.

If necessary the condenser banks can be by-passed altogether by an isolator. When in use however a spark gap is connected in parallel, via a damping choke and resistance and should the voltage across the condensers become excessive this gap will flash over and in doing so operate a by-pass air blast circuit breaker to permanently short out the capacitor bank. Flashover occurs at about 2.9 times the normal full load voltage. These banks are connected in a bridge circuit so that should a fault occur on one element an out of balance current flows across the bridge and actuates the same by-pass circuit breaker as does the spark gap.

Furnace regulation is achieved by relays which maintain a constant ohmic resistance between each electrode and the neutral point of the furnace. This is done by measuring the current, the voltage and the power factor on each electrode and having a two element relay, one element sensitive to the product E.I. cos ϕ and the other element sensitive to I^2. Then on the operating element of the relay $k_1EI \cos \phi$ is balanced by k_2I^2 where k_1 and k_2 are constants.

If $k_1EI \cos \phi = k_2I^2$ then $\frac{E \cos \phi}{I} = k_2/k_1$ and $R = a$



Method of connection of the electrodes

constant. Variations are automatically corrected by raising or lowering the appropriate electrode.

The secondaries of the furnace transformers each consist of four parallel windings, in order to achieve the high currents required, and these feed to the furnaces via copper busbars of 15 in by 0.47in section. Eight parallel busbars of this size run from each end of the single-phase units, being interleaved with each other in such a way, taken in conjunction with the connections from the four parallel windings, as to minimise the inductive reactance.

The sixteen busbars in each of the three groups leading to the furnace go to a point mid-way between two electrodes where they divide up, one half (representing one end of the transformer winding) going to one electrode and the other half to the other, via the cables and water pipes already referred to. The transformer secondary is thus connected in delta with a star connected load.

Tapped off one of the electrode supplies close to the furnace, via a solitary busbar, is a supply to a steel lance used as an electrode to burn open the taphole when tapping the furnace lower down. A small reactor limits the actual current which can be taken.

Daily production is planned to be between 150 and 200 tons of pig iron with a consequent output of 60-70 tons of slag. One of the 60 ton ladles used, on its carriage for direct transportation to the mixer in the steel house, is illustrated: tapping is at 4-5 hour intervals. It is hoped that the yearly output of each furnace will reach 70,000 tons. Slag is granulated by high-pressure water and stored under water, being subsequently pumped to the slag dump.

We are indebted to A/S Norsk Jernverk for the facilities and help they have given us in the preparation of this short series of articles and to Electrokemisk A/S for the cross sectional view of the iron furnace and for some of the photographs which we have reproduced.

E.A.W. Conference

ADDRESSES AND EVENTS AT LLANDUDNO

THE Electrical Association for Women made history in two ways by holding its annual conference in North Wales for the first time, at Llandudno from 1st to 3rd May, and by organising a conference to learn of power sources and uses in the year when the first nuclear power station is to be inaugurated at Calder Hall. The 400 delegates represented many of the Association's 160 branches, and each came with a background knowledge of electricity supply in her own area. The president, the Dowager Lady Swaythling, O.B.E., presided at all functions, ably supported by Miss Norah Balls, J.P., chairman, E.A.W.

Official blessing was given to the conference at the open session in the Pier Pavilion on 1st May, when Councillor John Owen, J.P., chairman of the Llandudno Urban District Council, paid a tribute to the E.A.W.'s contribution to modern living through its educational programme. He and his colleagues gave a delightful reception at the Winter Gardens that evening, when the famous Girls' Choir of Caernarvonshire gave great pleasure to guests.

The 31 branches in the North Western, Merseyside and North Wales Areas expressed their greeting through Mrs. H. Walsh, Area Federation chairman, and on 2nd May they gave a party when traditional Welsh singing was among the entertainment.

At the open session Mr. J. L. Ashworth, A.M.I.E.E., A.M.I.Mech.E., chief generation engineer (operation) of the North West, Merseyside and North Wales Division, C.E.A., spoke of the need to bridge the gap between electricity consumption and coal production, for it was estimated that in 1980 electricity consumption would be 3½ times the present figure. The Government had therefore embarked on the most ambitious programme of any country in the world, that of constructing twelve nuclear power stations by 1965. While hydro-electric power in Great Britain was only 2·6 per cent of the total power resources, there were seven important hydro-electric stations in North Wales. The delegates would see those at Dolgarrog and Maentwrog. The proposed pumped storage project at Ffestiniog would have a generating capacity of 300 MW and would be the first of its kind in the country. Another interesting scheme was planned on the Rheidol.

Mr. D. H. Kendon, M.I.E.E., M.I.Mech.E., chairman, Merseyside and North Wales Electricity Board, gave his greetings and welcome to the members and elaborated his theme of electricity in North Wales at the annual luncheon.

A lecture-demonstration entitled "Light for Living" by Mr. E. B. Sawyer, manager, E.L.M.A. Lighting Service Bureau, was both practical, stimulating and spectacular. He stressed the safety, efficiency and amenity aspects of modern lighting, and showed that, despite rising prices, the cost of tungsten filament lighting was no higher now than it was a generation ago; with the most efficient fluorescent lamps the cost was only about one-third as much.

A comprehensive vote of thanks to all the morning's speakers was given by Miss N. Balls.

At the annual general meeting a message was read from Dame Caroline Haslett, D.B.E., expressing her regret that continued illness prevented her being present and sending her best wishes for the conference. A telegram of greeting was sent in reply.

As a result of a ballot, the seven vacant places on the National Executive Committee were filled by Miss N. Balls, J.P.; Mrs. S. R. Bird; Mrs. E. Boot, J.P.; Mrs. A. T. Dover, B.Sc.; the Dowager Lady Swaythling; Mrs. E. A. Gibson; and Mrs. A. R. Hutchison, M.A. The other members of the Committee are: Councillor Mrs. Letitia Bell; Mrs. W. S. Carty; Mrs. C. U. Cole, L.L.A.(Hons.); Mrs. Mark Fraser, M.B.E.; Mrs. H. C. Gregory, O.B.E.; Miss N. Kenyon; Mrs. A. B. Lewis, J.P.; Miss H. Shaw, B.Sc.; Mrs. G. A. Tatchell, J.P.; Mrs. H. F. Truman; and Mrs. N. G. Wallace.

At a following meeting of the National Executive Committee the Dowager Lady Swaythling was re-appointed president; Miss N. Balls, chairman; Miss H. Shaw, vice-chairman; and Councillor Mrs. Letitia Bell, hon. treasurer.

At the annual luncheon on 2nd May regret was expressed from Brigadier Wynne-Finch, Lord Lieutenant of Caernarvonshire, that illness prevented him from proposing the toast of the Association. In doing so the Deputy Lord Lieutenant, Lt.-Col. Sir Goronwy Owen, D.S.O., showed a great appreciation of the E.A.W.'s aims and achievements in helping, through electricity, to release women from domestic drudgery for higher pursuits. He made a plea for more rapid extension of electricity supplies

in rural areas on the same basis as the postal services.

In her response Miss Beryl Nield, J.P., president of the Chester Branch, spoke of the wonders of the electrical age. There had been great women pioneers in education, nursing, medicine, prison reform and household management, and there had been distinguished women Ministers of the Crown in Education, Food, and Health; it was with these three vital issues that women were primarily concerned, and it was to these that E.A.W. work was directed. The Association looked to the future generation through its affiliation of girls' schools.

A group of delegates at the Maentwrog hydro-electric power station

In proposing the toast of "Working Together for the Common Good" Mrs. Eirene White, M.P., urged the extension of rural electricity supplies and the inclusion of more women in the Consultative Council and district committees, as one-quarter of the electricity used in the "Manweb" area was for domestic purposes.

In reply Mr. Kendon said that in 1955 ten times as many (13 million) householders were using electricity as in 1925 (1,200,000), and were using thirty times as much. On average each household was using three times as much as when the E.A.W. starting educating 31 years ago. In 1925 the average price of electricity for domestic purposes was about 4d a kWh, and in 1955 it was only 1½d despite the great rise in the cost of coal.

In the seven years since nationalisation three million consumers had been connected, and electricity sales had increased by 50 per cent. The number of farms connected had increased by 84 per cent, and over 60 per cent of all farms were now connected. Manweb had added over 200,000 consumers, and nearly half of these were in the Sub-Area which was mainly North Wales. Last year 1,863 farms were connected, which was substantially more than the 1,290 a year planned for the past three years of the programme, and 1,200 farms were expected to be connected in the current year. Cookers and water heaters were connected at the respective rates of 15,000 and 10,000 a year. He emphasised the value of electric floor heating; of infra-red lamps for heating; and of the heat pump for larder cooling and bath water heating.

Lady Swaythling presented the Lady Hughman Challenge Bowl to Mrs. Holland (Gravesend), winner of the golf competition.

In a choice of eight visits delegates were able to combine electrical interest with the pleasures of mountain scenery and historic castles. Tours went to Holyhead Dock Works; Hotpoint Electric Appliance Co., Ltd.; two woollen mills; a corsetry manufacturer's; the University of Wales, Bangor; and the hydro-electric stations at Maentwrog and Dolgarrog, the last also including the rolling mills and works of the Aluminium Corporation.

Two interesting exhibitions were held during the week, and the E.A.W. had a stand at each. Lady Swaythling opened the "Exhibition of Modern Living" in the Electricity Service Centre, organised by the Board and Division; she was introduced by Mr. R. N. Pegg, Sub-Area manager. Mrs. Peter Thomas, wife of the M.P. for Conway, opened the "Careers Exhibition" organised in the Town Hall by the Rotary Club of Llandudno, which was visited by parties of schoolchildren from all over North Wales.

Mr. D. H. Kendon speaking at the luncheon. On his right is Mrs. Eirene White, M.P. The president, the Dowager Lady Swaythling, is on the left of the picture

Royal Society Conversazione

THE annual conversazione of the Royal Society was held on 10th May at Burlington House, London, and in connection with this event the customary exhibition of apparatus was arranged to illustrate recent discoveries and new techniques of investigation in many diverse branches of science. For example, the Post Office Research Station showed what is being done in an attempt to compress telephone speech into a compass comparable with that of a telegraph channel. This is done by transmitting not the original sound waveforms, but instructions to a synthesiser to generate new sounds conveying the same message. The controlling analyser operates with parameters closely related to the voluntary articulatory movements of the talker's vocal organs. Another interesting exhibit in the same field of activity was a "compandor," a device to reduce the effect of noise and cross-talk in a telephone system.

Germanium and silicon monocrystals were shown by the solid-state physics section of the Aldermaston Research Laboratory of Associated Electrical Industries, Ltd. There was also a demonstration of germanium and silicon p-n junction rectifiers, showing how silicon devices remain effective at temperatures where germanium devices become useless. The silicon "solar battery" was shown operating a battery trickle charger, and there was also a transistor driven oscillator circuit.

Illuminating Engineers

Summer Meeting at Harrogate

THE biennial Summer Meeting of the Illuminating Engineering Society was held at Harrogate last week under the chairmanship of Mr. A. G. Higgins, M.Sc., F.R.I.C., president of the Society. Over 400 members and ladies were present.

A pre-meeting tour for overseas visitors started from London and included visits to Windsor, Oxford and Stratford-on-Avon on Sunday, 6th May, visits in Coventry and Birmingham on the Monday and in Sheffield and near Doncaster (Glass Bulbs, Ltd.) on the Tuesday.

The Summer Meeting proper started on Tuesday when there were alternative visits to the Hudson Road Mills, Leeds, of Montague Burton, Ltd.; the Nunroyd Mills, Guiseley, of J. J. L. & C. Peate; and the factory of Glass Bulbs, Ltd., at Harworth, near Doncaster. In the evening there was a full attendance at a reception by the Mayor of Harrogate, Councillor Robert J. Riley, J.P., at the Royal Hall, which was followed by dancing.

Light and Colour

On Wednesday morning after the official opening by the Mayor a paper on "Light and Colour in Daily Life" was presented by Dr. J. W. Strange, A.R.C.Sc., and Mr. H. Hewitt, A.M.I.E.E., who demonstrated their subject by full-scale stage equipment. The paper gave a general review of lighting conditions to-day. The authors said that in devising a practical approach to artificial lighting development there was a greater need for diversity to secure the right effect in the right place at the right time. They also discussed non-uniform luminance, direction and diffusion and variety of colour under the main heading "The Need for Diversity." Dealing with the techniques and basic elements of the lighting installation, the authors said that accent lighting had to be handled with care, otherwise hard contrast and disturbing shadows were produced. This technique was illustrated in dining rooms where a decorative background might be a window covered by a venetian blind lit from behind. The accent lighting on the table was provided by local incandescent sources and the general lighting by concealed lamps in coves or beams.

The president, Mr. Guy Campbell and Dr. J. W. T. Walsh

Accent lighting on the table is provided by local incandescent sources and the general lighting by concealed lamps in coves or beams (Strange & Hewitt's paper)

In opening the discussion Mr. J. M. Waldram contended that if they knew what they wanted and the designer was a man of reasonable ingenuity, then he was certain the desired lighting effect could be obtained without going into too much detail. He expressed himself against the idea some people had that everything should be embraced by a uniform range of brightness. The authors of the paper had pointed out the advantages of not having ceilings quite so bright, and Mr. Waldram said that in most installations ceilings were very much brighter at night than they were, relatively speaking, by day.

Mr. H. E. Bellchambers stressed the need for caution in colour and lighting schemes in houses.

Mr. C. J. King noted that one purpose of the paper was to stimulate interest in new ways of lighting the home. He wondered if they could not have a fluorescent lamp of two colours, one half pink and the other blue, rounded off with a pelmet.

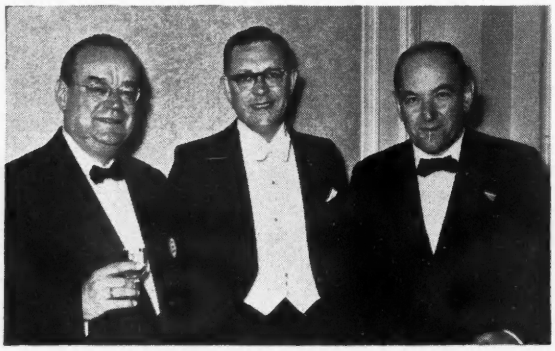
Mr. J. G. Christopher declared that if one decided to use colour lighting, it had to be done carefully and cleverly to avoid the crudities which prevailed when some people did not have the proper blends.

Small Factories

In the afternoon a paper on "Lighting of Small Factories" was presented by Mr. J. S. McCulloch, who dealt in the main with lighting in the type of factory found on the North-East coast trading estates. Daylight factor was calculated and an estimate made of the number of hours that artificial lighting would be required during an average year for varying values of illumination. The annual cost of lighting installations using different lighting sources was compared, taking into account the annual charges on wiring installations, replacement of fittings and the cost of electricity consumed.

Mr. R. Green, who opened the discussion, thought the author might have spent a little more time on electrical installations. It was not always advantageous to use trunking, thus putting all the eggs in one basket.

Mr. C. Dykes Brown dwelt for some time on cold cathode fluorescent lighting which, he said, was developed as long



Professor L. Schneider (Germany), Mr. A. G. Higgins (president) and Mr. J. Havelka (Czechoslovakia)

ago as 1937. The lecturer had quoted average lumen output figures as 15,000 hours, but the speaker claimed that 25,000 hours would be nearer the mark. It might be difficult, on the grounds of economics, to justify cold cathode lighting in small factories, for the question of maintenance was no small part of the decision to install or not. He would like to see reflectors cleaned more regularly.

Mr. L. H. Hubble, describing the paper as "valuable and factual," said he had found that on a basis of "20ft candles," trunking just about "broke even." Trunking was useful for a number of purposes, among them intercommunication, "Music While You Work," and even G.P.O. lines.

Dr. R. G. Hopkinson was of the opinion that effort should be made to reduce levels of glare in the smaller factories.

Maintenance of Equipment

"A Critical Analysis of Lighting Equipment and its Maintenance" was the subject of a paper by Mr. J. Mortimer Hawkins and Mr. C. J. Veness. The paper gave typical examples of what was considered to be economical maintenance in factories, offices and stores. Among the data given for a typical small factory were the following: number of 5ft twin fluorescent reflectors, 20; height above floor level, 20ft; average initial level of illumination, 15 lumens/sq ft; reflectors accessible from downshop crane platform; frequency of cleaning, four times per annum; frequency of re-lamping, once per annum; approximate time of use per annum, 4,200 hours; cost per annum for cleaning and re-lamping service, about £48.

Mr. S. Anderson, in opening the discussion, expressed the view that maintenance men should know their job when it came to dealing with fluorescent lighting fittings and there was no excuse for inefficiency. Dirt was a nuisance in practically every sphere of lighting and while much could be done towards reducing it by way of design; in the long run it might be more economical to shut it out of the building altogether.

Another point which would considerably help towards more efficiency was the position of the starter. If this was placed at one end of the room, say, near the door, maintenance would be facilitated.

Mr. C. Hughes thought that contractors wanted something that caused them no bother at all, thus getting a lot of money for the least possible work.

Replying to the discussion, Mr. Veness spoke of difficulties experienced when it was found that certain fittings did not join up well to the conduit or whatever system was in operation. He thought it reasonable to ask for some standardisation of certain components. Concerning the "complaints" about design of lighting equipment, he would describe them more as suggestions to contractors to help towards some degree of standardisation which would lead to more economical maintenance of equipment.

Late on the Wednesday evening a display of new lighting equipment was introduced by Dr. J. W. T. Walsh, O.B.E., president, International Commission on Illumination.

On the Thursday morning there were alternative visits to the following factories: Rowntree & Co., Ltd., York; Hailwood & Ackroyd, Ltd., Morley, Leeds; and J. Cawthra & Co., Ltd., Bradford.

Developments in Germany and Czechoslovakia

The first of two papers presented on the Thursday afternoon was "Lighting Developments in Germany" by Professor Ludwig Schneider. This paper dealt in particular with offices, shops, schools, churches, theatres and other public buildings. The influence of current trends in architecture on lighting was discussed and reference made to new departmental stores in which daylight had been reduced and in some cases excluded entirely, resulting in a more even load on generating plant and a longer and more useful life of the installation. Trends in shop window lighting, new lighting for railways and new ideas of exterior lighting were also described. The author referred to developments in the use of glass and plastics for fittings and in the application of colour-corrected mercury lamps.

Opening the discussion, M. Jean Chappat (France) noted that technical development of lighting in Germany and France had followed nearly the same course for about 20 years. The appearance of the fluorescent lamp on the market had upset former lighting methods, and years elapsed before proper lighting fixtures were designed. In the meantime, fluorescent lamps were used without lanterns, and many lighting engineers thought all the efforts to eliminate glare and to educate people about how to avoid it had been in vain. But, although the technical evolution as a whole seemed to have followed the same course in the two countries, and he supposed in England too, it was not quite the same in the artistic field, judging from the samples of fixtures Professor Schneider had shown. This proved that every country cherished a definite style and change in form and colour was slower than change due to technical progress.

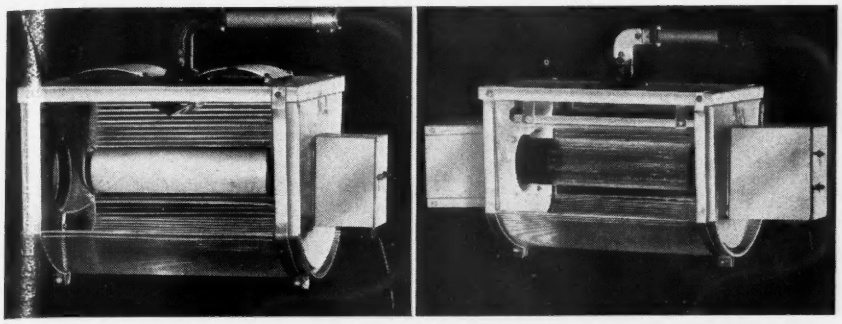
Mr. H. E. G. Watts questioned the comparative popularity of various types of light sources in street lighting, especially regarding fluorescence. He asked the author to make some forecast of the change in relative degrees of popularity of lighting sources in the future.

Mr. H. Long, expressing interest in the fluorescent bulb lamp, said that when they had had more experience, and development had been taken further in Britain, this would be a very important lighting source.

Mr. A. H. Nash said he would appreciate further comments by the speaker on the question of desirable ceiling brightness patterns, and asked if there was a tendency in Germany these days for the glass reflector lamps of the long-lasting type to replace reflector spot lamps.

Mr. Robinson asked the author what kind of lighting he would recommend for secondary roads and what type was being used in Germany. Was the use of high-pressure fluorescent mercury lamps influenced by the cost of energy?

The second of the papers was "Lighting Developments in Czechoslovakia" by Ing. Jiri Havelka. One of the items of research which was dealt with in some detail concerned the most economical and effective use of fluorescent lamps on a large scale. The large building programme provided a unique opportunity for full-scale experiments with different types and arrangements of fittings to be carried out and the results of these experiments were given. The effect of ambient temperature on the light output of fluorescent lamps had received attention for in Czechoslovakia outdoor temperatures as low as −8 deg F in winter were not uncommon. Only standard fluorescent lamps were manufactured at present, so that special fittings for low-temperature operation had had to be developed. The paper included data on the cleaning of industrial lighting equipment, and of windows.



Experimental lanterns used in street lighting tests (Ferguson & Stevens' paper) Left: Mercury. Right: Sodium

Mr. A. G. Penny opened the discussion and pointed out that they knew how much light was required to do a particular job, and he thought the industry should make efforts to get light and energy in the most economical way. If they could make lamps to last, say, two thousand hours instead of one thousand, they would, of course, use only half as many lamps and also 10 per cent more energy. The cost of that extra energy in terms of manpower, however, would be much greater than the saving in the manufacture of the lamp. Lamps with a life of 500 hours were a nuisance because of the frequency with which they had to be changed. In England, we were fortunate in that lamps were relatively cheap and tended to become cheaper while power tended to become more expensive.

Mr. J. M. Waldram pointed out that the amount of power consumed remained the same whether the component was clean or not. Moreover, when some lamps were left dirty, more lights were put on to make up for them, and that increased power consumption. The biggest trouble was not the total burning hours, but how often lamps had to be replaced.

Thursday's proceedings were concluded in the evening by the president's reception and the Society's annual dinner and dance at which the president also took the chair.

In proposing the toast of "The Illuminating Engineering Society" Dr. J. W. T. Walsh, O.B.E., referred to his 42 years in the service of the Society. The Society, he said, had always been internationally minded and the papers read in the afternoon preceding the dinner, by Professor Schneider and Mr. Havelka were strong evidence of that international aspect. He was confident that the International Commission on Illumination (of which Dr. Walsh is president) could rely on the support of the Society.

In response to the toast, Mr. A. G. Higgins (president) acknowledged with gratitude the support the Society received from the lighting industry, including the manufacturers of equipment and the suppliers of energy.

Mr. H. G. Campbell, proposing "The Guests," pointed out that although Dr. Walsh and Mr. Waldram were at the function as the Society's guests, they were also members. He made special reference to the overseas visitors, particularly the authors of the two papers presented that afternoon.

Councillor R. J. Riley, J.P., the Mayor of Harrogate, replied to the toast.

Coloured Light Sources

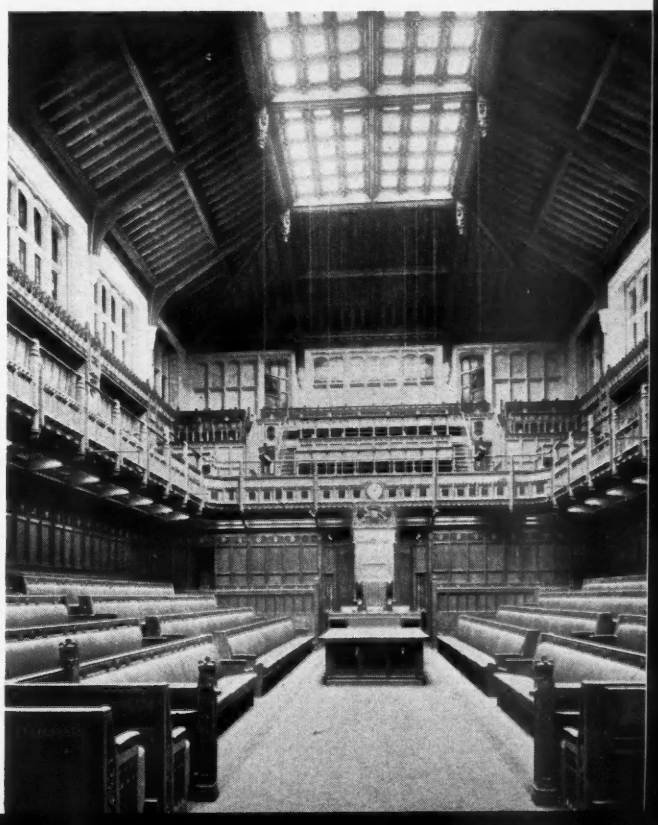
The Friday session opened with the presentation by Mr. H. M. Ferguson, A.M.I.E.E., and Mr. W. R. Stevens, B.Sc., M.I.E.E., of a paper on "Relative Brightness of Coloured Light Sources." Laboratory experiments to compare the apparent brightness of mercury and sodium light sources of high luminance had shown that most observers did not judge brightness on the ordinary photometric scale. In some circumstances the mercury luminance had to be reduced to one-third of that of sodium before observers, on balance, judged them to be equally bright. Methods of appraising observer preference were given in detail. The authors said it would be unwise to conclude from the laboratory experiments that reduced glare was the cause of preference for sodium street lighting because there were so many other factors that entered into street lighting installations. A series of experiments was therefore carried out to compare sodium and mercury street lighting installations designed to be similar in all respects except colour. The authors said it appeared that a majority of road users preferred sodium street lighting to high-pressure mercury, but it was not easy to decide why such a preference was expressed.

Opening the discussion, Mr. A. W. Christie considered that the number of observers mentioned by the lecturer was insufficient to give really accurate results.

Mr. T. L. Robinson said he would like to know whether the tests in the paper were made on dry or wet surfaces. Mr. F. H. Pulvermacher, referring to colour in lighting, pointed out that in daylight, green fields and blue skies made a restful picture, and he would have thought lighting in those colours would give the same peaceful effect, but this did not appear to be the case. With regard to street lighting, more light was obtained for less money with sodium lighting than with mercury.

Another speaker wondered what could be done about the glare from fluorescent lamps which appeared to be used more and more in street lighting. He urged Messrs. Fergusson and Stevens to continue research in that direction to help provide good visibility in the streets at night.

Mr. Holmes said it had been shown that a light of shorter dominant wavelength was apparently brighter than a light



An outstanding post-war London building, the House of Commons, represents, with the Royal Festival Hall, completely successful solutions of the integration of lighting and architecture in widely differing styles. (Durrant's paper)

Symmetry is being successfully challenged by asymmetrical free arrangements. (Durrant's paper)

of longer wavelength on some photometric luminance. Mr. J. M. Waldram also spoke and there was a brief reply to the discussion.

The final paper was on "Decorative Lighting—A Designer's Approach" by Mr. D. W. Durrant, who demonstrated his subject by full-scale stage equipment. Assuming that lighting was an integral part of interior decoration, the paper examined the approach of a designer when dealing with a known interior and compared this with the problem of designing fittings for a catalogue. In reviewing the trend of design, the author referred to colour, form, light and shade, contrast and novelty, and considered the factors which influenced changes in fashion, taste and technique. Symmetry, said the author, was being successfully challenged by asymmetrical free arrangements with their greater visual interest. Since the war London had been fortunate in getting two outstanding buildings which were world famous examples of decorative art, namely, the new House of Commons and the Royal Festival Hall.

Mr. C. W. M. Phillips, the first speaker, thought that the biggest problem in introducing acceptable lighting was the difficulty of reconciling the outlook of the artist with that of the mechanical and electrical engineer. There seemed to be a feeling that the designer either came into a project at the very beginning, setting an impossible job for the electrical engineer, or he came in at the end when he was faced with an impossible task left by the engineer.

Mr. A. G. Penny thought Mr. Phillips' problem of getting the artist and engineer to work together was basically simple to solve, so long as the designer could appreciate and understand that the electrical engineer had a job to do and so long as the latter understood that there had to be an artistic designer somewhere in the proceedings.

Dr. H. H. Ballin noted that Dr. Strange had shown a domestic interior made flexible by various built-in designs and by adjusting lighting, whereas Mr. Durrant had shown a more static "set-up" embracing the fixed ceiling point and plug points, illustrating the varied lighting which could be achieved in this way. The answer, he thought, lay about half-way between. What was wanted was to make home lighting flexible in the sense of changing the shades, some of the new designs of which were more suitable than the elaborate conventional types which cost much more.

Mr. P. E. Smith thought that if one wanted efficient lighting in the simplest possible manner and at low cost, there were a number of types of fittings to go for, but one could not go far wrong if a relatively small number of fittings was selected.

Mrs. E. B. Sawyer expressed the view that better quality products were needed. It was not always the design that people tired of, but the "cheapness" of the product.

In his reply to the discussion, Mr. Durrant said that however good designs were, people became tired of them, and the real test came if a return was made to a certain design.

The Summer Meeting concluded on Friday afternoon with the Society's annual general meeting and extraordinary general meeting.

Registered Electrical Contractors

THE report of the Registration Board of the National Register of Electrical Installation Contractors for 1955 presented at last Monday's annual general meeting shows that the number of contractors on the Register fell to 831. During the year 23 new certificates were issued but 63 names were removed from the Register for various reasons (34 because of non-renewal of certificate).

Two inspecting engineers operated throughout the year and the report stresses that their work is educative: they are not merely fault-finders. The standard of work required of certificate holders is said to have been generally well maintained. Thirty-seven inspections were made of applicants' work and there were 468 routine re-inspections of certificate-holders' work.

Reference is made to the projected National Inspection Council and gratification is expressed at the election of Mr. P. V. Hunter (the Register's chairman) as chairman of the National Inspection Board designate. Regret is expressed at the death of Mr. F. W. Purse, who was connected with the Register from its inception, and Mr. W. A. H. Parker, a member of the Board. Messrs. R. H. Rawll and J. J. Looker have continued to act as the Register's representatives on B.S.I. committees dealing with electrical accessories.

The Board's thanks are accorded to Messrs. R. H. Rawll and H. W. Swann, the Inspection Committee, Mr. Forbes Jackson, scrutineer, Mr. P. V. Hunter, chairman, Mr. E. A. Mills, vice-chairman, Mr. D. B. Irving, hon. treasurer, and Mr. A. Montgomery, secretary, and his staff.

Mr. Hunter said that that was probably the last annual meeting. The formation of the National Inspection Council had reached a stage at which only formalities remained to be settled. The matter was in the hands of the Board of Trade and would probably be approved in the course of a week or two. All the arrangements were ready to be "triggered off" by the National Inspection Board. The new Council would have the advantage of taking over the Register's offices and he hoped that the Registration Board's work over so many years would bear fruit in the new organisation.

Aluminium Development Association

AT the annual general meeting of the Aluminium Development Association, held at 33, Grosvenor Street, London, W.1, recently, the retiring president, Dr. H. W. Clarke, presided and introduced the report for 1955. The outstanding event of the Association's year was the exhibition held at the Royal Festival Hall, in June, to mark the centenary of the first production of aluminium in Britain. Good progress was made in the major fields of development, especially in building, marine, road and rail transport and electrical engineering. Among research activities were the continuation of various aspects of current structural research, also of fundamental investigations in the fields of road and rail transport. The information and educational services of the Association were especially active. New and revised publications were issued in addition to four numbers of "The Aluminium Courier."

PARLIAMENTARY REPORT

Restrictive Trade Practices Bill

In the resumed committee debate on the Restrictive Trade Practices Bill a series of amendments was proposed to Clause 20 (which gives a manufacturer power to enforce individual resale price maintenance by legal proceedings) seeking to give a retailer power to take action against a rival retailer who sold branded goods at below the stipulated price. Mr. Thorneycroft, President of the Board of Trade, said the Clause gave suppliers the right, which they never had before, of enforcing prices in the courts against both wholesalers and retailers. In the case of "loss leaders" it would be in the interests of the manufacturer to take action under the Clause because he would be anxious to retain the goodwill of all retailers. If cross actions were started by retailers every time there was a sign of price-cutting, he did not know what the end would be.

The amendments were withdrawn.

Mr. Eric Fletcher proposed to amend the Clause so that action could not be taken against a retailer unless there was a written contract about the prices of goods. He and others found the phrase "with notice to the retailer" too vague.

Mr. Thorneycroft said there would be no difficulty if all manufacturers had written contracts with wholesalers and retailers about prices, but trade was not carried on like that. The method of giving notice of resale prices varied according to the habit and fashion of each trade. To ensure that manufacturers would not unjustly get injunctions against retailers there was the safeguard that the court would not grant one unless satisfied that proper notice about prices had been given to the retailers.

The amendment was negatived.

A group of Labour members interested in the Co-operative movement sought to provide in the Clause that the granting of a dividend should not be treated as a breach of a condition as to resale prices. Mr. Thorneycroft said that no new right was given by the Clause, but there was a new method of enforcing existing rights about resale prices. Whether this was right or wrong must be settled in the division lobbies.

The amendment was negatived.

Select Committee on Nationalised Industries

Mr. Nabarro asked the Prime Minister if he would state the intentions of the Government in regard to the Special Report of the Select Committee on the Nationalised Industries.

Sir Anthony Eden said the Government had considered the Report, and proposed to set up a Select Committee with new terms of reference, namely, to examine the reports and accounts of the nationalised industries whose controlling boards were appointed by Ministers and whose annual receipts were not wholly or mainly derived from monies provided by Parliament or advanced from the Exchequer. The necessary motion would be placed on the Order Paper and there would be an opportunity to debate the matter then.

Mr. Herbert Morrison said the Prime Minister had referred to "the reports and accounts" of the public corporations coming before the Committee. Did this mean that wages and conditions negotiated between the unions and the industries would be brought before the Committee? If they wanted these industries supervised meticulously, politically, either by Select Committee or by the Government, it would be better to take them under the direct jurisdiction of State Departments rather than give them a degree of day-to-day managerial freedom.

Sir Anthony Eden said these were not points which could be settled by the Select Committee. This was admittedly an experiment to see if this method would be more effective in dealing with the nationalised industries than had been possible hitherto. He wanted the House to approach it with an open mind to see whether they could make a success of it. There would be full opportunity for debating the motion which would be tabled on this subject.

Later, in the debate on the coal industry's new borrowing powers, Sir Edward Boyle, Economic Secretary, Treasury, said the Government intended that the new committee should be an important part of the House of Commons procedure.

Policy on Automation

Mr. Owen asked the Minister of Labour if he was aware that the introduction of automation in industry was giving rise to serious misgiving among the organised workers, and Mr. Woollam asked him what action his Department was taking to consider the consequences of automation in the employment field.

Mr. Iain Macleod said that technological development had for many years been a feature of our economic life and automation was its latest and most novel form. It was welcomed by the Government and responsible opinion on both sides of industry as essential to our future efficiency and therefore to the continuance of full employment. They should also recognise the very natural anxiety that its introduction might cause. There were bound to be employment problems involving the redeployment of labour. New skills would certainly be required.

These problems could be satisfactorily resolved if the Government and both sides of industry worked in close co-operation. It was essential that firms which were contemplating the introduction of automation should in their planning consider from the beginning how it would affect their workers and bring them into early discussion. On its side the Government accepted a continuing responsibility for maintaining the general level of demand. It would also help to meet the special effects in the employment field of technological changes by making provision, as already announced, for a wide extension of technical education; by encouraging opportunities for training; and by assisting through its employment services workers who had to change their employment. These problems were being studied by universities and other bodies and by the Department of Scientific and Industrial Research.

In the light of the D.S.I.R. report he intended to discuss the whole question with representatives of the employers, the trade unions and the nationalised industries on the National Joint Advisory Councils and, as appropriate, his Government colleagues would have similar discussions with other advisory bodies.

The Government believed that if all those concerned played their part in this way these new changes with their unlimited possibilities for the future would prove of immeasurable benefit to the prosperity and happiness of the nation.

Coal Industry Investment

The problem of filling the gap between British coal production and the nation's growing demand for energy was the cause of a division in the ranks of Conservative M.P.s when the House of Commons debated the Coal Industry Bill which increases from £300 million to £650 million the advances to be made to the National Coal Board to finance their new investment programme.

Mr. Gerald Nabarro led the Conservative group who opposed the Bill on the ground that it did not give Parliament sufficient control and permitted a large increase in public expenditure upon an undertaking which had made continual losses despite heavy capital investment. Their motion to refuse the Bill a second reading was defeated by 143 votes to 23, the Opposition abstaining, and the second reading was carried.

The Minister of Fuel and Power, Mr. Aubrey Jones, said the demand for energy was rising faster than at

any time since the Victorian era, at a rate equivalent to 5-6 million tons of coal a year. Of the primary fuels needed to satisfy the demand, 85 per cent was represented by coal. Oil was a supplement and the Government had a target for conversion to oil which would involve trebling the use of black oils by 1960. Nuclear power, another supplement, was designed to effect by 1965 a saving of 5-6 million tons of coal. If this programme went according to plan every power station established about 15 years from now would be a nuclear power station. It was a minimum programme and as the national economy allowed it would be expanded and accelerated.

Technical resources and skilled manpower imposed limits to the programme. Another limitation was that nuclear developments provided energy in only one form, electricity, which at present met only one-sixth of our energy requirements. Even so, the use of electricity was steadily rising by 8 to 9 per cent a year, making electricity, with oil, one of the fastest growing sources of power in the whole economy. If we were to adopt a policy of dispensing entirely with coal and substituting for it nuclear power, we should have to expand the use of electricity even faster than now. We should have to scrap, long before the end of its economic life, much equipment now designed to use coal. We should have to enforce a massive conversion to electricity. After having done that, we should still find ourselves with important and extensive uses for coal for which electricity could not be substituted—for instance, blast furnaces. It was clear that for as long ahead as it was useful for us to peer we should need more coal than we were now getting, even allowing for economies achieved through the use of fuel-saving equipment which the Government was encouraging. The Minister then went on to outline the Coal Board's plan for increasing efficiency and output. Concerning current coal production, he said the outlook was somewhat better than it was last year, although it would be imprudent to count on any significant increase in the total year's output over last year's 210 million tons. The revised plan of the Coal Board was designed to increase the output to 240 million tons in 1965.

Atomic Power Programme

Mr. Renton, Parliamentary Secretary, Ministry of Fuel and Power, told Mr. Warbey that no decisions had been taken regarding an expansion and acceleration of the atomic power programme beyond the limits of the plan set out in the White Paper of February, 1955.

Future of the D.S.I.R.

Mr. Eric Fletcher asked when the Government would give effect to the recommendations of the committee of inquiry into the Department of Scientific and Industrial Research.

Mr. Bevins said the recommendations in the committee's interim report, recently published as a White Paper, formed the basis of the main provisions of the Department of Scientific and Industrial Research Bill, which had passed through the Lords. The committee's final report, which was not being published, did not make positive recommendations for action now but contained a number of suggestions for the consideration of the new Research Council which it was proposed to set up under the Bill.

Shared Television Masts

In reply to Mr. Vane, the Postmaster-General (Dr. Hill) said that where the area to be served was broadly the same, mast sharing by the B.B.C. and the I.T.A. was the ideal solution on technical as well as æsthetic grounds. At his request they were studying their siting problems from this point of view.

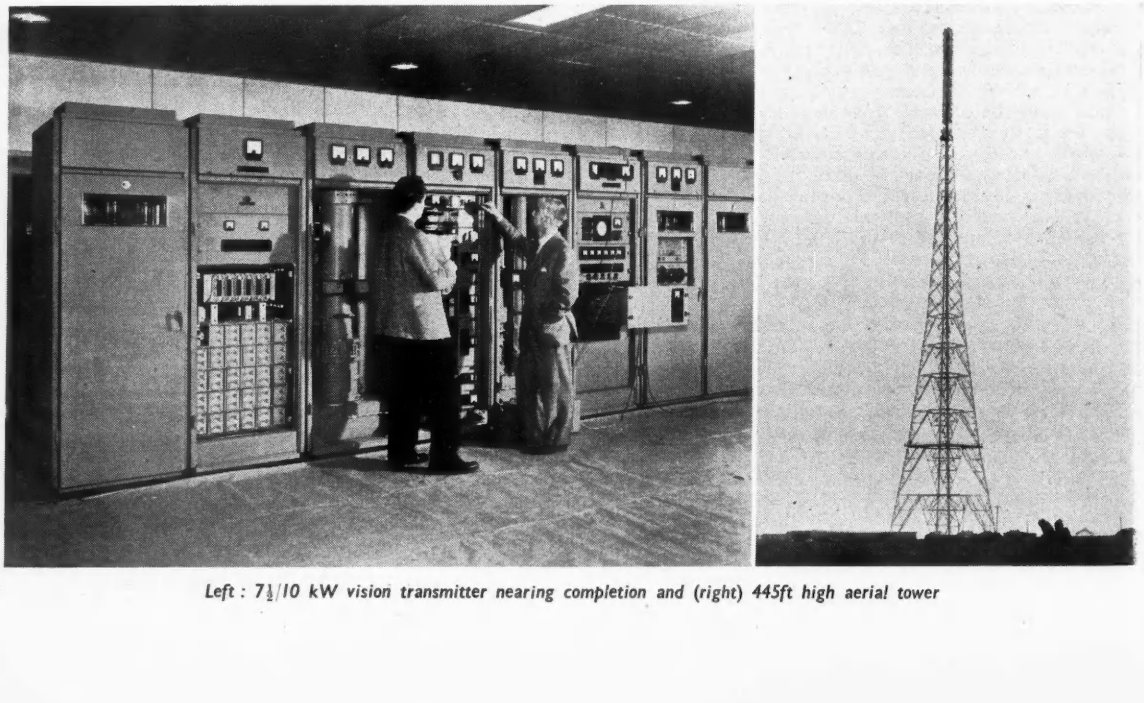
Technical Manpower

In reply to Mr. Martin Lindsay the Minister of Labour said he was considering a proposal from the Federation of British Industries that first and second class honours graduates in science and engineering who wished to take employment in industry should not be called up. This suggestion needed very careful examination and he was not yet in a position to make a statement.

Northern Television Station

On 3rd May Winter Hill, the Independent Television Authority's first station in the north of England, went into programme service. Marconi's Wireless Telegraph Co., Ltd., were responsible for completing the entire station. Some idea of the work involved may be gathered from the fact that before it could begin, a 7ft layer of peat had to be removed before a solid foundation was reached.

The vision and sound transmitters installed are 7½/10 kW and 2½ kW, respectively, and the outputs from these are combined and fed to a sixteen-stack aerial, producing an effective radiated power (vision) of 100 kW. The aerial tower is 445ft in height and the station is sited at a height of 1,440ft above sea level.



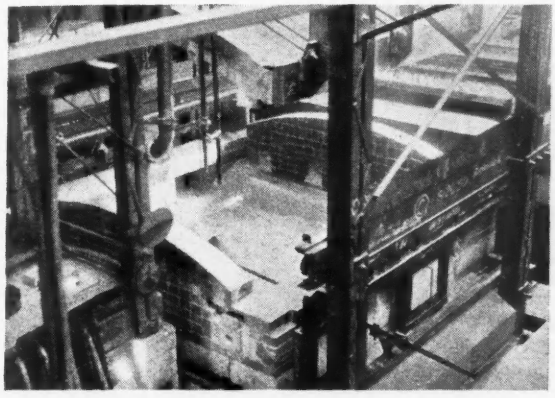
Left : 7½/10 kW vision transmitter nearing completion and (right) 445ft high aerial tower

Electric Glass Furnace

AN all-electric glass melting furnace has been developed and put into operation by the British Heat-Resisting Glass Co., Ltd., of Bilston, Staffs, the makers of "Phœnix" glassware.

The furnace, which the company is now able to make available to other glass manufacturers, can be used with nearly all types of commercial glass. Advantages are that on a production size unit, the capital cost can be as little as half that of the conventional furnace. Maintenance costs are also halved. In many areas, running costs in terms of fuel consumption are 25 to 30 per cent lower in the manufacture of bottle glass, compared with the conventional furnace. Operation is at unity power factor.

The heat losses from a conventional furnace are very large; even under optimum conditions up to 95 per cent of the heat generated is wasted in heat-losses. Compared with this, the all-electric furnace loses only about 40 to 50 per cent and it is expected that this thermal efficiency will be improved upon.



The melting chamber of the new furnace, from above. The furnace crown can be seen at the top of the picture. When starting up this is lowered and heat applied by flame to the raw material until it has melted sufficiently to allow the free passage of the current

Heat is engendered in the glass in a six-sided rectangular melting chamber by electrodes on two of the facing walls. The raw batch is fed in at the top and forms a carpet over the entire surface; this, while allowing the gases given off by the melting glass to pass through it, forms an insulating ceiling over the melting process. The glass is passed downwards through a zone of maximum temperature and as its resistance during the melting is higher than that of refined glass, the electrical current lines will tend to concentrate towards the bottom of the chamber and so provide a zone of greater heat just where it is required for the final refining of the glass. The lower grade heat given off by the glass particles within this zone is transmitted to the surface where it is still sufficiently high to melt the underside of the batch crust. Thus, as the glass is withdrawn from the base of the melting chamber, so is melting glass liquefied from the underside of the batch crust, which is replenished by fresh material as it becomes used up.

The conception requires the precise and flexible control of a substantial power input at uniquely high temperatures. The electrical apparatus feeding the electrode faces in the melting chamber consists in its simplest form of three power transformers, transforming the mains voltage up or down to that required. Each is connected with an infinitely variable voltage regulator. This regulation is important and can, in fact, be achieved either by means of stepless voltage regulators or by saturable reactors. The former are better as they provide a less peaky waveform to the current cycle passing through the glass.

Once such a furnace is installed, it is calibrated carefully, the power required for a given rate of melting for a specific glass being critical. Once calibrated, however, the furnace becomes self-regulating within limits of 5 per cent on either side of the conditions set for any rate of throughput, tending to hunt towards the appropriate conditions rather than away from them.

Other advantages of this type of furnace are that it requires much less space and no special building is needed to house it. Also, such a furnace can be installed in only six weeks instead of the six months or more necessary for a conventional furnace.

Actual operation is simple and extremely flexible. The throughput can be varied as desired with very little difficulty, and it has been shown in practice that the furnace will work economically and efficiently down to half its maximum capacity, if required to do so, which would be most uneconomical with a fuel-fired furnace. Again, it takes less than two days to change the furnace product to a different type of glass, compared with up to three weeks for the conventional type. After a shut-down, the all-electric furnace takes only six days to start again, whereas with a fuel-fired type this may take up to three weeks.

N.C.B. SPECIFICATIONS

SPECIFICATION No. P.139/1956, "Rubber insulated armoured cables for power, lighting and control," has been issued by the National Coal Board. It is available from the Production Department, N.C.B., Hobart House, Grosvenor Place, London, S.W.1, price 3d.

The object of this specification is to standardise a limited number of sizes and types of vulcanised rubber insulated armoured cables for the normal requirements of the Board. It covers two-core and multi-core v.r.i. armoured cables for use on systems up to 3,300 V for power, roadway lighting and control and interlock circuits. It is required that cables to this specification shall comply with the requirements of B.S. 2008 as regards construction, dimensions and quality of materials, except where modified by this specification, and shall be subject to the tests prescribed therein. The standard sizes of conductor are given for each of the three classes of cable: Power 0·01 to 0·3 sq in; roadway lighting 0·0045 to 0·0145 sq in; and control 0·002 and 0·0045 sq in.

Cable constructions are also given for the three broad classes of cable, each of which is sectionalised. For instance, "cables for power purposes" includes one section "over 660 V and up to 3,300 V DWA earthed or unearthed," the construction being three-core cable, vulcanised rubber insulated, compound rubber sheathed, double wire armoured, cotton taped and jute braided and compounded overall, suitable for 3,300 V working pressure.

The Board has also issued a list of specifications and standards in two sections—recommended specifications and mandatory specifications. In the first section are: P.3/1950, flameproof air-break electrically operated gate-end box, size 1; P.4/1950, flameproof air-break electrically operated gate-end box, size 2; P.7/1950, flameproof air-break circuit-breaker; P.8/1950, air-cooled flameproof single-phase lighting transformer gate-end box for M.T. supply; P.9/1950, flameproof air-break electrically operated 50 c/s drill gate-end box; and P.10/1950, flameproof air-break electrically operated 150 c/s drill gate-end box. The second section includes: P.102/1954, dimensions of 3-phase non-flameproof electric motors; P.108/1954, universal non-flameproof mining-type transformers for use below ground for primary voltages up to 3·3 kV; P.109/1954, standard non-flameproof mining-type transformers for use below ground for a primary voltage of 3·3 kV; P.129/1955, surface and underground voltages; and P.130/1955, intrinsically safe remote control circuits when associated with restrained plugs and sockets.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 23rd May from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1945

12369. Barker, G. C.—Wave operated selective electric control system. 16th May, 1945. (749,300.)

1950

7609. Lacey, C. L.—Electric systems. 27th March, 1951. (749,301.)

1952

7580. Young, S. G.—Snap-action electric switches. 24th June, 1953. (749,305.)

12596. Victoria Machine Tool Co., Ltd., and Frye, J., and Seidel, A.—Electric controlling apparatus, particularly for machine tools. 19th August, 1953. (749,245.)

16456. Busch-Jaeger Dürener Metallwerke Akt.-Ges.—Control switch for electric cooking ranges and the like. 30th June, 1952. (749,246.)

17572. Standard Telephones & Cables, Ltd.—Polarised magnet system particularly for one coil ringers. 11th July, 1952. (749,247.)

28146. Siemens & Halske Akt.-Ges.—Electric capacitors. 7th November, 1952. (749,438.)

31170. Standard Telephones & Cables, Ltd.—Electrical calculating equipment. 9th December, 1952. (749,440.)

31652. Mutron, Ltd.—Electronic testing instruments. 11th December, 1953. (749,441.)

32641. Sangamo Weston, Ltd.—D.c. amplifiers. 23rd December, 1952. (749,251.)

1953

1769. Telefonaktiebolaget L. M. Ericsson.—Apparatus for indicating abnormal operation of one or more electrical devices within a group of such devices. 21st January, 1953. (749,442.)

3577. Everett, Edgcumbe & Co., Ltd.—Electrical repeating devices. 9th February, 1954. (749,368.)

3976. Graham & Co., Ltd., A.—Pole fitting for an electric street lantern. 21st April, 1954. (749,309.)

4806. British Thomson-Houston Co., Ltd.—Sealed components. 18th February, 1954. (749,370.)

5088. Electric & Musical Industries, Ltd.—Cathodes for electron-discharge devices. 5th February, 1954. (749,256.)

6164. Calor-Emag Elektrizitäts-Akt.-Ges.—Pressure-proof housings for electric switchgear. 5th March, 1953. (749,373.)

7986. Mullard Radio Valve Co., Ltd.—Electronic storage or memory devices. 21st May, 1954. (749,447.)

10475. Sebel Soc. Anon. — Electronic fluorescent illuminating lamp. 16th April, 1953. (749,448.)

12216. Electric & Musical Industries, Ltd.—Indirectly heated cathodes for electron-discharge devices. 29th April, 1954. (749,312.)

12438. Sharp, J. R., and Kaye, E.—Storage-battery charging devices. 5th May, 1954. (749,452.)

13306. Hotpoint Electric Appliance Co., Ltd. — Temperature responsive electric switches and cut-outs. 6th May, 1954. (749,313.)

15999. General Electric Co., Ltd., and Williams, C. E.—Electric circuit arrangements for operating groups of lamps in sequence. 10th September, 1954. (749,381.)

16597. National Research Development Corporation.—Ferro-resonant circuits. 4th June, 1954. (749,383.)

17855. Funditor, Ltd., and Strobel, A.—Thermostatically controlled electric switches. 16th June, 1954. (749,386.)

18712. Bernstein, A. C., Seaman, P. H., and Karr, N. A.—Electromagnetic relays. 6th July, 1953. (749,316.)

19212. British Thomson-Houston Co., Ltd.—Manufacture of tubular electric-discharge lamps. 9th July, 1954. (749,271.)

20497. Eléctricité de France.—Transformer on-load tap-changing equipment. 23rd July, 1953. (749,317.)

21100. General Electric Co., Ltd., Francey, J. L. A., and Kirkness, R. H.—Arrangements for supplying direct current. 29th July, 1954. (749,318.)

21547. General Electric Co., Ltd., and Goodman, C. H. L.—Semi-conductor amplifying devices. 4th November, 1954. (749,272.)

23694. Mallory Metallurgical Products, Ltd.—Manufacture of electrical contacts. 12th November, 1954. (749,390.)

25088. General Electric Co., Ltd., and Tombs, N. C.—Apparatus for the manufacture of powdered materials. 20th August, 1954. (749,265.)

25453. Western Electric Co., Inc.—Magnetic storage computers. 15th September, 1953. (749,207.)

26022. Metropolitan-Vickers Electrical Co., Ltd.—Open-cycle gas-turbine plant. 10th June, 1954. (749,267.)

26378. Radio Corporation of America.—Semi-conductor devices. 24th September, 1953. (749,392.)

26387. General Electric Co., Ltd.—Luminescent materials. 23rd September, 1954. (749,393.)

26542. Hamilton, W. R., and Phillips, K. J.—Method and apparatus for electrically heating paint, cellulose, and like compositions. 18th August, 1954. (749,394.)

27075. Oak Mfg. Co.—Electrical apparatus. 2nd October, 1953. (749,268.)

27601. Muller, J.—Coupling unions for pipes and other articles of cylindrical outer form such as electrical conductors or the like. 7th October, 1953. (749,395.)

28914. National Research Development Corporation. — Dynamo-electric machines. 19th October, 1954. (749,480.)

29369. British Thomson-Houston Co., Ltd.—Speed responsive apparatus. 19th October, 1954. (749,270.)

30226. Philips Electrical Industries, Ltd.—Bucky grid X-ray apparatus. 1st October, 1954. (749,397.)

32996. English Electric Co., Ltd.—Electric switches of the enclosed type. 26th November, 1954. (749,484.)

34771. Metropolitan-Vickers Electrical Co., Ltd.—Electrostatic meters. 8th October, 1954. (749,403.)

35352. Compagnie Générale de Télégraphie sans Fil.—Backward wave oscillator tubes. 18th December, 1953. (749,281.)

35523. British Thomson-Houston Co., Ltd.—Methods of and means for electro-erosion. 15th November, 1954. (749,486.)

35774. White-Ibbotson, Ltd.—Automatic vision gain control for television receivers and like apparatus. 5th October, 1954. (749,487.)

1954

376. Lambert, R. B.—Electric torches. 6th January, 1954. (749,492.)

2562. Bosch Ges., R.—Electric switches having bridging contacts. 28th January, 1954. (749,284.)

2620. Naamlooze Vennootschap Fabriek Van Electrische Apparaten Voorheen F. Hazemeijer & Co.—A.c. electric circuit-breaker. 28th January, 1954. (749,211.)

4258. British Insulated Callender's Cables, Ltd.—Manufacture of insulated electric cables. 11th February, 1955. (749,288.)

5292. British Insulated Callender's Cables, Ltd.—Means for supporting an overhead electric traction conductor. 22nd February, 1955. (749,331.)

8111. Standard Telephones & Cables, Ltd.—Radio frequency circuits. 19th March, 1954. (749,337.)

8753. Philips Electrical Industries, Ltd.—Circuits for the transmission of video-signals to a transmission line. 25th March, 1954. (749,296.)

9434. Standard Telephones & Cables, Ltd.—Measurement of group delay in electric communication systems. 31st March, 1954. (749,297.)

10236. British Thomson-Houston Co., Ltd.—Circuit arrangements for electric-discharge tubes. 7th April, 1954. (749,216.)

10237. General Electric Co.—Electrical apparatus. 7th April, 1954. (749,495.)

11523. General Electric Co.—Magnetic amplifier circuits. 21st April, 1954. (749,217.)

12727. Brown, W. J.—Electric motor control systems. 3rd May, 1954. (749,220.)

13972. Radio Corporation of America.—Magnetic switch assembly. 12th May, 1954. (749,346.)

22968. Rogoff, M.—Electrical system for indicating the presence of or rate flow of a fluid. 6th August, 1954. (749,230.)

23101. McGraw Electric Co.—Magnetic cores for stationary electrical induction apparatus. 9th August, 1954. (749,418.)

25652. British Thomson-Houston Co., Ltd.—Lamp-wrapping machine. 3rd September, 1954. (749,234.)

28360. Standard Telephones & Cables, Ltd.—Method of refining silicon. 1st October, 1954. (749,423.)

35847. British Thomson-Houston Co., Ltd.—Manufacture of electron emissive cathodes. 10th December, 1954. (749,429.)

36425. Soc des Brevets Wagner.—Control apparatus for an electric motor. 16th December, 1954. (749,238.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 2nd June:—

POLISCRUB. No. 749,267. Class 7. Electrically driven machines (not for domestic use) for polishing and scrubbing floors.—Rapid Electric Scrubbing Co., Ltd., 22-24, Rolleston Street, Leicester.

HIL-O. No. 745,485. Class 9. Radio and television aerials and masts.—Antiference, Ltd., 67, Bryanston Street, London, W.1.

GENOTON. No. 738,760. Class 9. Electrical apparatus and instruments; radio, television, sound reproducing, recording and amplifying apparatus, etc. — Anorgana G.m.b.H., Gendorf (OBB)-Werk, Germany. Address for service, c/o Abel & Imray, Quality Court, Chancery Lane, London, W.C.2.

PYEGRAM. No. 741,064. PYEPHONE. No. 741,065. Class 9. Radio and television apparatus and parts; electric oscillation generators; batteries; accumulators; germanium diodes, transistors and other semi-conducting devices; echo-sounding instruments and apparatus, etc. PYETELECOM. No. 749,562. Class 9. Radio and television apparatus.—Pye, Ltd., St. Andrews Road, Cambridge.

No. 748,647 (design). Electrical and electronic apparatus and parts.—Chapel Developments, Ltd., Albion Works, Albion Place, Prestwich, Manchester.

PANALOG. No. 749,369. Class 9. Electrical apparatus and instruments, etc.—Panelit, Ltd., Dalston Gardens, Stanmore, Middx.

ACTINETTE. No. 749,724. Class 10. Electro-medical appliances.—Perihel, Ltd., West Mall Works, 27-29, Rabbit Row, London, W.8.

TERANEX. No. 749,753. Class 17. Electrical insulating materials made of synthetic resin.—British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.

GENERATION AND DEVELOPMENT

M.E.B.'s Rural Power Plan to Continue

Despite the 10 per cent cut in its capital allocation for the current year, the Midlands Electricity Board hopes to maintain the pace of its rural development programme. This was stated by the chairman of the Board, Mr. W. S. Lewis, when he addressed the annual meeting of the Shropshire Parish Councils Association at Shrewsbury last Saturday. He said that the Board's original estimate of capital expenditure was £6,800,000. This had been cut to about £6,200,000, and they were at present engaged on the difficult task of deciding what work had to be omitted and how the total was to be allocated between the Sub-Areas. To date they had been spending at the rate of £1,000,000 a year on rural development and they were most anxious not to reduce its pace, at least until they had reached the objective which their industry had set—to get 85 per cent of farms on supply in the next five years.

Mr. Lewis remarked that he had taken a great personal interest in rural development, and one of the first jobs the M.E.B. did when it was established was to survey the area. There were about 26,500 farms and only 7,500 of them had mains electricity. To-day more than 17,700 farms were connected.

Power Station Batteries

The first power station in the country to be equipped with the new HPB high performance cells made by the Tudor Accumulator Co., Ltd., is Marchwood generating station, now being built near Southampton by the Southern Division of the Central Electricity Authority. These new cells were specially developed, in co-operation with the C.E.A., for high rate discharge work in power stations and substations. One 240 V and two 110 V batteries have been installed with their control gear in separate rooms.

In an emergency the 240 V battery maintains essential loads up to 158 kW until a diesel generator can be started. The generator then supplies the emergency loads in conjunction with the battery and a 240 V mercury arc emergency rectifier. The two 110 V batteries are used for e.h.v. switch closing and tripping, indication and control. All three are mounted on double tier wooden stands and equipped with automatic constant potential float trickle charge rectifiers.

For the underground battery room of its Invergarry project, the North of Scotland Hydro-Electric Board has installed a 110 V main station battery and a smaller 50 V installation for l.p. services and all charging/control gear for both. The main battery consists of 90 Nife heavy duty, low resistance cells, with a capacity of 275 Ah for switch closing and emergency lighting.

The 50 V battery comprises 38 Nife normal-resistance cells (capacity 32·5 Ah at the 10-hour rate) housed in the lower compartment of its control cubicle. Under emergency conditions, it will supply an intermittent load of 1·5 A for telephones and indication for twelve hours.

Canadian Output in 1955

A total of 76,297 million kWh was produced at Canadian central electric stations in 1955, 10 per cent more than in the preceding year (69,137 million kWh). Consumption rose from 66,536 million to 72,020 million kWh. Quebec accounted for nearly half of the all-Canada output, the year's production being 35,845 million kWh; Ontario was next with 25,336 million kWh.

Indian Power/Irrigation Scheme Opened

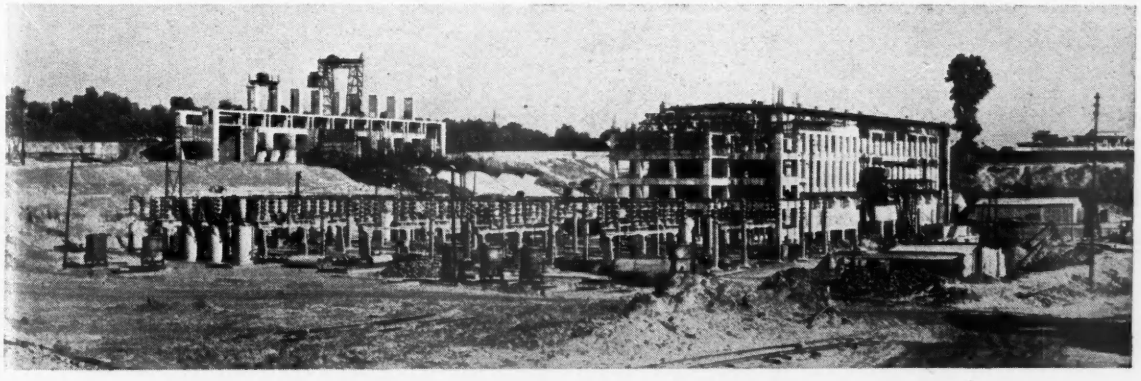
On 27th April Dr. Sampurnanand, Chief Minister of Uttar Pradesh, India, officially opened a new power station near the village of Khatima in the north of the province on the borders of Nepal. The Khatima station is part of an extensive irrigation scheme which includes the important Sardar canal system. Water supply for the new power house is taken from the main canal, passes through the turbine generators, each of which is fitted with a hydraulically operated isolating shutter device, and the water is then returned to the main canal a few miles downstream. The electrical energy generated at Khatima is to provide tube-well irrigation for areas not served by the Sardar canal. It will also be used to increase industrial development in the remoter parts of the province over which it will be fed through a series of transmission lines and substations now being built.

The contract to supply and erect all the plant and equipment for the power house, intake hydraulic equipment, discharge regulators, transformers and switching station, has been carried out by the English Electric Co., Ltd., and the major items of equipment have been designed and manufactured at the company's Stafford and Rugby Works.

Khatima power station is equipped with three 19,200 b.h.p. vertical feathering propeller type water turbines operating at a speed of 167 r.p.m. for a 59ft head. An interesting feature of design is the hydraulically operated isolating shutter device fitted to each turbine to allow the passages between the spiral casing stay-vanes to be closed when required, so that maintenance work on the turbine runner and vane apparatus may be done without emptying the spiral casing. Discharge regulators connected to each spiral casing also permit the full load of water to pass through the casing while the isolating shutters are closed. The control gear of the discharge regulators allows a constant flow of water through the spiral casing irrespective of the load on the machine.

The 13·8 MW vertical shaft umbrella type alternators generate at 11 kV, and this is stepped up by three 17·5 MVA three-phase 50 c/s transformers and fed into the network through bulk oil type circuit-breakers at 132 kV.

Khatima (Uttar Pradesh) power station under construction. In the left background are the upstream gates



Financial Section

STOCKS and SHARES

AS in the previous week, the main interest in the industrial markets of the Stock Exchange has been focused on the reaction of individual shares to company dividend and profit statements for 1955. In this respect the electrical equipment market has had mixed news. For the more disappointing results, the reasons appear as a rule to be connected in general with the credit squeeze, and with the effects of purchase tax and the hire-purchase restrictions upon the demand for the lighter forms of equipment. Few of this year's company statements do not echo in some form Sir Alexander Roger's references, in the Automatic Telephone & Electric report, to the rise in production costs through continuous wage increases, and the difficulty which this creates in the matter of keeping prices down to competitive levels in export markets. The general trend for both gilt-edged and industrial stocks has been distinctly towards the easy side.

British Aluminium Issue

Dealings began very briskly in the two million new £1 ordinary shares of British Aluminium, offered to shareholders at 40s. Starting at about 12s, the premium on the shares forged ahead to 16s 6d before reverting to 14s. This issue forms part of the arrangements for financing the first stage in the building of the aluminium smelter in Quebec, an operation which is thought likely to quicken transatlantic interest in the shares. Another £3 million is being raised in the initial form of bank loans. For 1955 British Aluminium is paying a 12 per cent dividend, from earnings equivalent to nearly 50 per cent on the capital ranking. On the assumption that the same rate will be paid after the increase, there is a prospective yield of just on 4½ per cent on the new shares at an all-in price of 54s (free of stamp).

C. A. Parsons

Since the appearance of the chairman's statement circulated with the company's 1955 report, the £1 shares of C. A. Parsons have been maintained at about the best price of the year. Sir Claude Gibb emphasised that the record results for the year were made possible almost entirely by the continuous capital investment programme, and despite the handicap imposed upon it by present rates of taxation. On the latter subject he says that in the past decade the company has paid to the tax collector nine times the amount distributed in dividends, and far more than the sums it has been possible to spend on capital improvements. It is with this and other aspects of the tax burden in mind that the directors have not recommended any increase in the year's dividend, although it absorbs no more than one-ninth of the net profit. A yield of under 2½ per cent on the shares demonstrates investment confidence in the long-term benefits of the company's policy of ploughing

Price Changes in

Company or Board	Nom. Value	Middle price 14th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield%	1956 Highest	1956 Lowest
						£ s d		
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	77½		3	3	3 17 6	80½	75
Brit. Elec. 1974/77	100	75½	−1	3	3	3 19 6	79½	73¾
Brit. Elec. 1976/79	100	79½	−2	3½	3½	4 8 0	84	78¾
Brit. Elec. 1974/79	100	90½	−1	4¼	4¼	4 14 0	95	88
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6†	6†	6 6 3†	20/9	19/-
East African Power	£1	20/-	−9d	7	7	7 0 0	21/3	20/-
Nigerian Elec.	£1	21/-		10	10	9 10 6	21/-	17/-
Palestine Elec. " A "	£1	21/-		Nil	Nil	Nil	21/-	21/-
Perak Hydro-Elec.	£1	16/-		10	10	—	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/9	−3d	17½	17½	6 17 3	13/6	10/6
Aerialite	1/-	5/6		88½	45*	8 3 6	6/9	5/-
Allen, W. H.	£1	75/-		20	20	5 6 8	78/-	67/-
Aron Elec. Ord.	£1	56/-	+3d	15	15	5 7 3	56/-	53/6
Assd. Automation	10/-	27/-		10	10	3 14 0	34/9	24/6
Assoc. Elec. Ord.	£1	71/3		14	15	4 4 3	85/6	57/9
Automatic Tel. & El.	£1	60/-	−2/6	15	15	5 0 0	72/6	59/6
Babcock & Wilcox	£1	77/-	−3/-	15	15	3 18 0	85/6	64/-
Baldwin, H.	2/-	5/-	+3d	20	20	8 0 0	5/-	3/9
Bakelite	10/-	30/-	+6d	16	16	5 6 9	34/-	26/9
Berry's Electric	5/-	6/6	+3d	—	10‡	7 13 9	6/3	5/9
British Aluminium	£1	53/-x.r.		12	12	4 10 6	57/-	40/6
B.I. Callender's	£1	50/9	−1/-	10	12½	4 18 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	22/-		6	6	5 9 0	22/6	20/3
British Thermostat	5/-	28/9		27½	27½	4 15 0	31/9	24/6
British Vac. Cleaner	5/-	6/9		30	15*	11 2 3	8/9	6/9
Brook Motors	10/-	40/-		20	25	6 5 0	44/-	40/-
Brush Ord.	5/-	7/-		10	10	7 2 9	7/9	6/3
Bulgin, A. F.	1/-	5/3x.c.		45	50	—	7/3	6/6
Burco Dean	5/-	9/6	+6d	—	22½	11 16 9	13/3	8/6
Chloride El. Storage " A "	£1	63/-	−9d	17½	17½	5 11 0	73/6	60/9
Clarke Chapman	£1	111/3	−1/3	20	22½	4 1 0	112/6	89/6
Cole, E. K.	5/-	17/6		27½	17½*	5 0 0	22/3	16/-
Cossor, A. C.	5/-	7/6	−3d	10	15	10 0 0	10/3	6/9
Crabtree	10/-	28/6		20	20	7 0 3	29/3	27/-
Crompton Parkinson Ord.	5/-	14/6		20	16*	5 10 3	15/-	12/3
De La Rue	5/-	19/-		20	30	7 18 0	20/3	15/-
Decca	4/-	30/-		56½	43¾*	5 16 9	44/9	24/9
Desoutter	5/-	27/3		25	30	5 10 0	32/9	25/9
Dewhurst	2/-	7/-		24	30	—	6/6	5/3
Dictograph Tel.	2/-	6/3		20	20	6 8 0	6/9	6/-
Dublier Condenser	1/-	4/-		25	25*	6 5 0	4/6	4/-
E.M.I.	10/-	28/9	−9d	10	15	5 4 3	37/-	27/-
Electrical Components	5/-	13/9		20	25	9 1 9	16/-	13/9
Elec. Construction	£1	28/9		15	8½	5 18 3	29/9	25/-
Enfield Cable Ord.	£1	15/9	−1/6	Nil	Nil	Nil	19/3	14/9
English Electric	£1	56/3	+1/3	12½	12½	4 8 9	66/3	47/3
English Electric 3¾% Pref.	£1	14/-	+6d	3¾	3¾	5 7 3	14/6	12/6
Ericsson Tel.	5/-	38/6	−6d	25†	25*†	3 5 0†	42/9	33/6
Ever Ready	5/-	29/-	−3d	35	35	6 0 9	32/9	24/-
Falk Stadelmann	£1	38/9		15	17½	9 0 9	45/9	37/6
G.E.C. Ord.	£1	57/6		12½	14	4 17 3	65/6	50/-
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 6	23/9	21/3
General Cables	5/-	12/9		30	30	11 15 3	13/9	12/9
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Cable	5/-	23/9		20	25	5 5 3	24/6	18/9
Hackbridge & Hewittic	5/-	19/3	+6d	25	30	—	22/-	17/3
Heatrae	2/-	4/9		12½	15	6 6 3	5/1	4/9
Henley's	10/-	19/3	−6d	10½	11½	5 19 9	19/9	14/-
Holophane	5/-	18/9		25	30	8 0 0	19/-	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend forecast.

back the bulk of current profits into the development of the business.

Automatic Telephone

Full accounts available now from Automatic Telephone & Electric confirm that the 15 per cent dividend for 1955 is covered as much as four times over by the net earnings of the year, which were within £26,000 of the previous figure. Trading profit of the group, before the deduction of a reduced tax charge, showed a larger decline. In the chairman's statement, sales are reported to have been the highest in the company's history, and orders on hand also to be larger than ever before; but profit margins have been narrowed by the inflationary trend, including the effects of perennial wage increases. Sir Alexander Roger points out that in telephone products the element of labour costs is unusually high, and the dependence on imported materials low. This position makes the equipment an ideal type of export (more than 60 per cent of output goes overseas) but particularly vulnerable to the result of wage increases. The chairman's references to the large sums spent upon research into such equipment as electronic exchanges indicate one reason for the high investment standing of the shares.

Electrical Investments

Company or Board	Nom. Value	Middle price 14th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	27/-	−6d	70	50	9 5 3	39/3	23/-
I.C.I.	£1	46/9	−1/9	10	10	4 5 6	49/9	41/3
Intl. Combustion	5/-	20/6		25	20*	4 17 6	25/-	15/3
Johnson & Phillips	£1	40/9	−6d	15	15	7 7 3	46/6	37/6
Lancashire Dynamo	£1	45/-		15	11*	4 17 9	49/9	40/9
Laurence, Scott	5/-	15/9	−6d	12½	15	4 15 3	16/9	13/3
Lister, R. A.	£1	34/3	+6d	9·3	10	5 16 9	35/3	27/6
London Elec. Wire	£1	51/3		12½	12½	4 17 6	52/9	46/6
Lucas, J.	£1	33/9	−1/3	7½	7½	4 9 0	40/3	31/3
Marryat & Scott	2/-	10/6	+3d	25	30	5 14 3	11/-	9/6
Mather & Platt	£1	59/-	+6d	13·4*	15	5 1 9	65/3	51/6
Metal Industries	£1	22/6	−1/3	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	47/6		10	12½	5 5 3	48/6	43/6
Morphy-Richards	4/-	23/9		35	50	8 8 6	27/3	21/9
Murex	£1	68/-	+6d	15	20	5 17 9	70/3	60/-
Newman Ind.	2/-	2/6		10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/6		17½	20	—	3/-	2/4
Parnall (Yate)	5/-	6/6		14	12	9 4 6	9/6	5/6
Parsons, C. A.	£1	85/-		10	10	2 7 0	85/-	61/6
Plessey	10/-	70/6	−9d	27½	30†	4 5 0	87/6	56/-
Pye "A" Deferred	5/-	18/-		20	12½*	3 9 6	21/3	14/-
Revo	10/-	11/-		9	9	8 3 6	11/9	8/3
Reyrolle	£1	110/-		15	16½	2 19 0	110/-	81/-
Rheostatic	4/-	8/6	+3d	22½	18½*	—	—	8/3
Richardsons Westgarth	5/-	16/-	−1/-	15	16⅔	5 4 3	17/-	13/9
Scottish Cables	4/-	17/9		27½	27½	6 4 0	17/6	15/9
Smith (England), S.	4/-	13/3	−3d	17½	17½	5 5 9	14/3	11/-
Southern Areas	£1	20/-	−7/6	10	7½	7 10 0	28/9	21/-
Strand Elec.	5/-	7/9		17½	15*	9 13 6	8/6	7/3
Sturtevant	5/-	25/3		14·4†	15†	2 19 6†	31/3	25/3
Sun Elec.	£1	36/-		15	20	11 2 3	37/6	36/-
Switchgear & Cowans	5/-	14/9		20	25	8 9 5	17/-	14/6
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	14/-	11/3
T.C.C.	10/-	42/6		25	25	5 17 9	43/-	40/6
T.C. & M.	£1	30/6		8½	8½	5 11 6	34/-	26/-
Telephone Mfg.	5/-	7/6		10	10	6 13 3	8/6	6/3
Thorn Elec.	5/-	18/9		20	15*	4 0 0	22/6	16/-
Thornycroft	£1	46/3		15	15*	6 9 9	49/9	41/3
Tube Investments	£1	66/3	−1/3	22½	14*†	4 4 6	70/6	54/9
Vactric	5/-	15/-		10	15*	—	15/-	11/6
Veritys	5/-	9/9	+1/-	12½	12½	6 8 3	10/-	6/9
Walsall Conduits	4/-	13/3	+1/3	70	70	—	13/6	10/9
Ward & Goldstone	5/-	37/6		50	30*	4 0 0	38/3	29/-
Watford	2/-	6/6	−3d	25	25	7 13 9	7/6	6/6
Westinghouse Brake	£1	81/3		18	18	4 8 6	100/-	71/6
West, Allen	5/-	14/6		15	15	5 3 6	14/6	11/6
Wolf Electric	5/-	19/-		20	20	5 5 3	26/3	19/-
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	79	−1	6	6	7 12 0	80	66
Ord.	100	50		3½	3½	7 10 0	54	45
Anglo-Portuguese	£1	23/-		8	8	6 19 3	23/6	20/3
Brit. Elec. Traction:								
Def. Ord. "A"	5/-	19/-		50	22½*	5 18 6	20/-	15/6
Cable & Wireless:								
Ord.	5/-	11/6		10	10	4 7 0	11/3	9/6
4% Loan	100	92		4	4	4 7 0	92½	88
Calcutta Trams	£1	23/-		6†	7½†	6 10 6†	26/3	23/-
Cape Elec. Trams	£1	17/6		5½	7½	8 11 6	20/3	18/-
Marconi Marine	£1	31/6		10	10	6 7 0	34/-	31/-
Oriental Tel. Ord.	1/-	77/6	+1/9	16	—	—	90/-	78/-
Telephone Rentals	5/-	11/9		12½	12½	5 6 6	11/9	9/9

J. & P. Loan Stock

Johnson & Phillips ordinary shares were not much altered, at 40s 9d, after the announcement of the decision to meet the company's capital requirements by an issue of £1·8 million unsecured loan stock, rather than by an offer of new shares. Market conditions are considered unsuitable for the latter course. The new loan stock bears interest at 5¾ per cent and is redeemable between 1971–76. It is being offered to preference and ordinary shareholders of the company at 97, the yield at that price being 5·9 per cent, or just over 6 per cent allowing for the capital profit on redemption. The cost of the annual interest on the stock is covered between five and six times over by the average profits of the last five years, and the principal amount four times by net assets of the group. In an accompanying statement, the company refers to a narrowing of profit margins, but expects to maintain reasonable earnings.

Lower Earnings

A reduction in the earnings of Southern Areas Electric Corporation last year is ascribed in the company's preliminary statement to increased wages and material costs, keener competition at home and abroad, the higher purchase tax and the financial restrictions. The £1 shares seemed to have been the object of some optimistic speculation in advance of the announcement, and the price came back sharply in the market to 21s 9d (the official quotation being 20s) on the company's decision to lower the ordinary dividend from 10 to 7½ per cent. Engineering & Lighting Equipment's preliminary results for the year ended in March show a reaction from the high level of profits attained in the previous twelve months, but the present state of business satisfies the directors that they are justified in repeating the final dividend at 15 per cent, making a total of 20 per cent for the year. The 2s shares subsequently changed hands at around 3s 9d.

REPORTS and DIVIDENDS

Babcock & Wilcox, Ltd.—The report and accounts for 1955 now issued confirm the figures given in our issue of 4th May.

In his circulated statement, Mr. W. L. Fraser (chairman) says that it is owing to the need to conserve their resources, and especially having regard to the present difficulties of the national economy, that the board felt it undesirable to recommend any change in the dividend on the ordinary stock. The preparations made over the past eight years to play their part in the field of nuclear energy have resulted in their obtaining further contracts from the United Kingdom Atomic Energy Authority in connection with the Calder Hall "B" and Chapel Cross installations. Throughout the year production has been well maintained, although the shortage of skilled labour and of draughtsmen has been the constant concern of managements. Turnover exceeded the record figures attained last year. The order book, both home and export, has been encouraging in 1955, which will remain outstanding as a year in which substantial contracts have been received not only from Africa, India, New Zealand and other Commonwealth countries, but also from many foreign countries. The company has made a successful start in the production and sales of oil-fired "packaged" boilers marketed under the name of "Steambloc." Extensive research continues on important problems of combustion and in the development and applications of metals and materials capable of withstanding the arduous conditions of service which will be required in the steam generating plant of the future. The company's arrangements for education and training have been revised so that they may considerably increase the intake of young men, not only for training as mechanical engineers but also as apprentices in the skilled crafts. Mr. Fraser briefly reviews the progress of the subsidiary companies, Edwin Danks & Co. (Oldbury), Ltd., Bailey Meters & Controls, Ltd., and Dewrance & Co., Ltd.

The Automatic Telephone & Electric Co., Ltd.—The annual meeting will be held on 30th May. In his circulated statement, Sir Alexander Roger (chairman) says that the lower profits are not due in any way to a slackening in the demand for their products, and in fact in 1955 the value of sales was again the highest in the company's history, while the value of unexecuted orders in hand is greater than it has ever been; manufacturing programmes budgeted for 1956 and 1957 show progressive increases. Lower profit margins are almost inevitable. At home the Government's intention that the Post Office should speed up the supply of telephones as quickly as the economic conditions of the country will allow is gratifying, and the adoption of a longer term three-year development policy will enable the Post Office Telephone Department to plan ahead. The demand throughout the world for automatic telephone switching and other telecommunications equipment continues to increase but British manufacturers are facing keener foreign competition. Under the agreement with the Indian Government in 1948 they undertook to assist in the establishment of the nationally owned factory of Indian Telephone Industries, Ltd., at Bangalore, in which they also have a minor financial interest. To meet the wishes of the South African Government they have agreed to embark on a larger scale project there. Their local manufacturing and sales company in Portugal has had another satisfactory year and further extended its manufacturing capacity. They have agreed with Marconi's Wireless Telegraph Co., Ltd., to join forces in order to offer complete telecommunications equipment in export markets. A major development likely to have a profound effect on the future of the telephone industry is the electronic exchange, examples of which will probably be put into service on a trial basis within the next two or three years.

Aberdare Cable (Holdings), Ltd.—In his review of the year ended 31st October last, Mr. F. J. Pascoe (chairman) says that the recovery in home business of Aberdare Cables, Ltd., indicated in the previous year's report was maintained. They were again successful in obtaining period contracts with most of the Electricity Boards and their cables have been installed at the Brimsdown, Hartshead and Skelton Grange power stations of the C.E.A. In addition, considerable orders were received from the National Coal Board, Government Departments and industrial users. Competition in the home market is strong and is likely to remain so, and the intensity and duration of the credit squeeze may affect home orders during the present year. Export orders were slightly less than in the previous year, but orders were received from new customers in face of severe competition. Two new products have been introduced since the last report: aluminium-cored lead covered cables, and fully impregnated non-draining paper insulated cable.

The manufacture by Aberdare Engineering, Ltd., of soot blowing equipment for the subsidiary, Ivor Power Specialty Co., Ltd., is being maintained at a steady level and orders for soot blowing equipment are in hand for several new power stations of the C.E.A. The volume of incoming business and output of South Wales Switchgear, Ltd., was a record, and the order book guarantees the company's business for the ensuing twelve months. The outstanding feature of the company's activities was the installation of 33 kV outdoor metal-clad switchgear, which is said to be the first of its type in the world. The company has a large order book for this class of gear for many parts of the country. During the year it completed a £250,000 contract at the atomic installation at Capenhurst. Exports, after a temporary recession, showed considerable improvement, and this has continued during the current year.

Johnson & Phillips, Ltd.—Particulars are now announced of the board's proposals to raise new capital, reference to which was made in the report and accounts for 1955 recently published. It is stated that owing to market conditions it is not desirable to raise money by an issue of share capital at the present time, and it has therefore been decided to raise the new capital by an issue of unsecured loan stock. Preference and ordinary shareholders are offered £1,800,000 5¾ per cent stock, 1971-76, at a price of £97 per £100 of stock, payable as to 10 per cent by 24th May, 40 per cent by 7th June, and 47 per cent by 5th July. The net proceeds of the issue, estimated at £1,720,000, will be used to repay bank overdraft and provide working capital.

In a circular to shareholders, the company states that the Elizabeth Works at New Cross were largely reconstructed in 1955 and it is expected that they will be substantially completed by the end of 1956. The purchase and reconstruction of Elizabeth Works has involved additional capital expenditure. The increase in cost of raw materials during the year, and the substantial increase of business, has inevitably necessitated a larger amount of capital being employed in current stocks and stores, and work in progress. There was a considerable expansion during 1955 in activities and interests overseas, involving capital expenditure of the order of £350,000.

The Engineering & Lighting Equipment Co., Ltd.—The trading profit for the year ended 31st March last is £131,713, as compared with £281,387 for the previous year, and after providing £61,750 for taxation, the net profit is £52,699 (against £129,272). The report states that despite the lower level of net profit, the directors are satisfied that the present state of the order book and current activity justify maintaining the final dividend at 15 per cent. The interim dividend was 5 per cent (against 15 per cent before the 150 per cent scrip issue). The balance carried forward is £142,255 (against £115,943 brought in).

The Ebonite Container Co., Ltd., in announcing an interim dividend of 10

[*Continued on page* 859

FINANCIAL SECTION (*continued*)

per cent on capital increased by a one-for-three scrip issue, states that it is intended to present the accounts earlier than last year and for this reason the directors do not contemplate a second interim. Last year there was an interim dividend of 5 per cent, a second interim of 12½ per cent, a final dividend of 5 per cent and a bonus of 7½ per cent, making 30 per cent for the year on smaller capital.

Lancashire Dynamo Holdings, Ltd.—The main figures in the accounts for 1955 were given in our issue of 20th April. In his statement, which has been circulated with the report and accounts, Sir Percy H. Mills, Bt. (chairman), says that the past year has seen continuous progress in both orders and sales generally throughout the group and this trend continues to date. Turnover has expanded in most sections, and while profit margins have been affected by rising costs, the accounts show improved earnings because of such increased turnover.

Dealing with the chief companies associated in the group, the chairman says that Lancashire Dynamo & Crypto, Ltd., introduced new ranges of standard a.c. motors during the year, not only to meet the home market, but also for the North American market. These new motors were a major factor in increasing sales to Canada and were a valuable dollar earner. There has been much development in the special equipments manufactured by Foster Transformers, Ltd., and new materials and new techniques have been greatly in evidence. The business of the Nevelin Electric Co., Ltd., in rectifiers and the production of Lancashire Dynamo Switchgear has been transferred to the new works at Oxted where considerable additions have been made to the buildings and equipment. Progress has been made in the performance and control of single-anode rectifiers.

The year has been marked by increasing popularity of the food preparing machinery made by Crypto, Ltd., and the orders and sales of automotive and aircraft servicing equipment and metal rectifiers for industrial applications of Crypton Equipment, Ltd., were higher than for the previous year. The demand for industrial electronic equipment made by Lancashire Dynamo Electronic Products, Ltd., has continued to increase both for Government and industrial use. During the year most of the balance of the ordinary shareholding in Dynamo & Motor Repairs, Ltd., was acquired, and this company now becomes a subsidiary.

The London Electric & General Trust, Ltd., is making an issue of 80,000 £1 ordinary shares at 37s 6d per share by way of rights to ordinary stockholders in the proportion of one for every £6 ordinary stock held. Consent of the Capital Issues Committee has been obtained. The new shares will not rank for the final dividend for the year to 30th June next, which the directors expect will be 10 per cent, making 14 per cent for the year. It is hoped to maintain the 14 per cent rate on the increased capital for the following year.

The Southern Areas Electric Corporation, Ltd.—The consolidated profit for 1955 is £79,674, as compared with £227,005 for the preceding year, and after deducting taxation of £44,495 and adding surplus tax of £8,233, the net balance is £43,412 (against £118,943), of which £40,244 is dealt with in the accounts of the holding company. It is proposed to pay a dividend for the year of 7½ per cent (against 10 per cent), and to carry forward £275,297 (against £265,673 brought in). The report states that the profits were hit by increased wages and material costs, keener competition and financial restriction.

Richard Johnson & Nephew, Ltd., report that after providing £686,268 for taxation, the group net profit for the year to 31st March last is £715,942, as compared with £661,721 for 1954-55. General reserve receives £590,717 and it is proposed to pay a final ordinary dividend of 6 per cent, maintaining the distribution for the year at 9 per cent. The special profit-sharing bonus to workpeople is again £20,000.

The Power Securities Corporation, Ltd.—The profits for 1955, before taxation, are £737,633, as compared with £693,037 for 1954, and after deducting £426,637 for taxation, the net balance is £310,996 (against £270,524). It is proposed to pay a dividend for the year of 10 per cent (against 9 per cent). The authorised capital is to be increased from £2,000,000 to £2,500,000.

Bowthorpe Holdings, Ltd., reports group net profits for 1955 of £291,124, as compared with £210,419 for 1954. Taxation absorbs £256,084. It is proposed to pay a final dividend of 25 per cent, making 35 per cent for the year.

Aerialite, Ltd., is paying an interim dividend of 18 per cent (against 17½ per cent).

New Companies

Berec Radio, Ltd.—Registered 20th March. Capital £10,000. Electricians, electrical engineers, manufacturers of and dealers in electrical and electronic appliances, etc. Directors: E. N. Rowbotham, F. W. Stevens, R. H. Spettigue, C. G. White and L. W. Orchard. Regd. office: Hercules Place, Holloway, N.7.

Electro Automat, Ltd.—Registered 22nd March. Capital £100. Manufacturers of and dealers in rectifiers, semi-conductors, electrical heating equipment, electro-mechanical goods, control equipment and servo-mechanisms, etc. Solicitors: Simmons & Simmons, 1, Threadneedle Street, E.C.2.

Magneto Dynamo & Ignition Services, Ltd.—Registered 10th April. Capital £15,000. Electrical contractors, etc. Directors: A. E. Orman, Maisie I. Orman and R. E. Orman. Regd. office: 114, Lodge Road, Southampton.

End & Williams, Ltd.—Registered 7th March. Capital £1,000. Manufacturers and distributors of, agents for and wholesale and retail dealers in electrical goods of all kinds, radio and television sets, etc. Directors: H. End and R. L. Williams. Regd. office: 2, Mount Street, Manchester, 2.

Manor Radio & Electrical Co., Ltd.—Registered 8th March. Capital £100. Directors: A. J. Pratt and C. S. Callingham. Regd. office: 91-93, Manor Way, Ruislip, Middx.

H. & L. Sims, Ltd.—Registered 8th March. Capital £1,000. To acquire the business of electrical contractors and radio and television engineers and service agents carried on by H. P. Sims and L. Sims at Walsoken, Wisbech, as H. & L. Sims, etc. Directors: H. P. Sims and L. Sims. Regd. office: Bertwill House, Chapnall Road, Walsoken, Wisbech.

McFarlanes Electric Tools, Ltd.—Registered 3rd April. Capital £1,000. E. J. McFarlane is the first director. Regd. office: 57, Lee High Road, S.E.13.

Hamilton Cole (Sussex), Ltd.—Registered 21st March. Capital £5,000. Electricians, etc. Directors: G. H. Cole, Beatrice Cole and P. H. Cole. Solicitors: Marsh & Ferriman, Worthing.

Hamilton Cole (Portsmouth), Ltd.—Particulars as above.

Increases of Capital

Vactric, Ltd.—Increased by £400,000, in 5s "A" non-voting ordinary shares, beyond the registered capital of £600,000.

Associated Electrical Industries, Ltd.—Increased by £10,000,000, in 8,500,000 ordinary and 1,500,000 unclassified shares of £1 each, beyond the registered capital of £35,000,000.

Besson & Robinson, Ltd.—Increased by £20,000, in £1 ordinary shares, beyond the registered capital of £10,000.

Modern Automatic Telephones, Ltd.—Increased by £45,000, in £1 ordinary shares, beyond the registered capital of £5,000.

Liquidations

Blakemore & Morgan, Ltd., electrical contractors.—Winding up voluntarily. Liquidator, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2, appointed 1st May.

Helecs Vehicles, Ltd., electric vehicle distributors, **Helecs Vehicles (Manufacturers), Ltd.,** electric vehicle manufacturers, and **Hindle Smart (E.V.S.), Ltd.,** electric vehicle spares distributors.—Winding up voluntarily. Liquidator, Mr. H. C. Gill, 10, Norfolk Street, Manchester, 2, appointed 4th May.

Bankruptcies

R. Powell, 28, Sedbergh Crescent, Newbold, Chesterfield, electrical goods retailer.—Receiving order made 1st May on debtor's own petition. Public examination 8th June at the Court House, Brimington Road, Chesterfield.

H. Smith, lately carrying on business as an electrical engineer at the Old Bakery, South Clifton, Notts.—Public examination 18th July at the County Court House, St. Peter's Gate, Nottingham.

P. C. Jarvis, Cavan's Cottage, Stafford Road, Huntington, Cannock, Staffs, electrician.—Receiving order made 4th May on a creditor's petition.

K. R. Clover, residing and carrying on business as K. R. Clover & Co., at 3, Market Cross, Sturminster Newton, Dorset, radio and electrical engineer.—Trustee, Mr. J. E. Ellis, 50, The Terrace, Torquay, Devon, appointed 5th May.

C. T. Boden, residing and carrying on business as a wholesale electrical, hardware and fancy goods dealer, under the style of the High Peak Wholesale Electrical Supplies, at 5, Hartington Street, Derby, and carrying on business as a retail electrical, hardware and fancy goods dealer, at "Anafon," Abergele Road, Old Colwyn, Flint.—First and final dividend of 3s 1d in the £, payable at 126, Colmore Row, Birmingham.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—3rd July. Department of Civil Aviation. Airport surveillance radar system. (E.S.B. 11909/56. Ten/19293.)*

Carshalton.—5th June. U.D.C. Street lighting equipment. (See this issue.)

Costa Rica.—28th June. Instituto Costarricense de Electricidad, San Jose. 30 km transmission line. (E.S.B. 12438/56. Ten/19315.)*

Garstang.—30th May. R.D.C. Supply of mercury vapour discharge lamps for street lighting in the period ending 31st March, 1957.

Greece.—4th June. Ministry of Finance. Telephone materials. (E.S.B. 11928/56. Ten/19280.)*

India.—1st June. Government of Andhra Tungabhadra Board. Control and power cables. (E.S.B. 11601/56. Ten/19212.)* 18th June. Three 15,000 kVA transformers for Garividi substation. (E.S.B. 11661/56. Ten/19214.)*

6th June. Director General of Supplies and Disposals. 1,100 V cable. (E.S.B. 11600/56. Ten/19211.)*

25th June. Electricity Department, Government of Madras. Synchronous condensers and allied indoor switchgear and accessories. (E.S.B. 12428/56. Ten/19306.)* 23rd July. 66 kV single circuit lines for Tanjore-Sivaganga and Sivaganga-Ramnad. (E.S.B. 11587/56. Ten/19271.)*

26th June. India Store Department, London. 15,000 recording blank discs. (See this issue.)

31st July. Director, Railway Equipment, Railway Board, New Delhi. Global procurement programme of rolling stock including electric motor and trailer coaches, locomotives and tower wagons. (E.S.B. 11877/56. Ten/19261.)*

Indonesia.—31st July. State Electric Company, Construction Directorate. Electrical materials, cables, junction pipes, etc. (E.S.B. 11658/56. Ten/19230.)*

Iraq.—3rd June. Government of Iraq. 100 kW diesel-electric generating set. (E.S.B. 12095/56. Ten/19279.)*

Jersey.—Sewerage Board. Contractors wishing to tender for electrical distribution and installation work at the waste conversion plant should apply by 31st May. (See this issue.)

Liverpool.—The Regional Hospital Board invites applications by 31st May from contractors to submit their names for inclusion in the Board's approved lists for general electrical engineering work, divided into five groups. Vincent Collinge, secretary to the Board, 19, James Street, Liverpool, 2.

London.—23rd May. Wandsworth Borough Council. Street lighting maintenance vehicles. (See this issue.)

New Zealand.—6th June. Posts and Telegraph Department, Wellington. 200 radio transmitter/receiver sets for vehicles. (E.S.B. 11845/56. Ten/19246.)*

15th June. General Post Office. 200 resistors. (E.S.B. 11699/56. Ten/19220.)* 22nd June. Adhesive tape. (E.S.B. 12470/56. Ten/19314.)* 11th July. 60 250 W h.f. transmitters. (E.S.B. 11692/56. Ten/19218.)*

24th July. State Hydro-Electric Department. 350 MVA, 11,000 V indoor switchgear. (E.S.B. 11842/56. Ten/19247.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Northwich.—4th June. U.D.C. Electrical installations in 60 dwellings on the Leftwich estate. J. R. W. Clark, surveyor, The Council House, Church Road.

South Africa.—8th June. City of Cape Town Electricity Department. Underground cables and jointing material. (E.S.B. 11917/56. Ten/19268.)*

14th June. Union Tender and Supplies Board. Radio parts and test equipment. (E.S.B. 11903/56. Ten/19243.)*

Tangier.—11th June. Water and Electricity Board. Electrical equipment and h.v. 5·5 kV feed for the transformer station "Mendoubia." (E.S.B. 11314/56. Ten/19231.)*

Thailand.—15th June. Telephone Organisation of Thailand, Bangkok. Auto telephone equipment. (E.S.B. 11860/56. Ten/19288.)*

United States.—5th June. Corps of Engineers, P.O. Box 867, Little Rock, Arkansas. Oil-filled pipe type cables. (E.S.B. 11533/56. Ten/19292.)*

Uruguay.—29th May. Administration de las Obras Sanitarias del Estado. Armoured cable and cable boxes for underground installations. (E.S.B. 11318/56. Ten/19242.)* 1,000 kW motor and accessories. (E.S.B. 11369/56. Ten/19260.)*

12th June. Administracion Nacional de Combustibles Alcohol y Portland. Electrical material including cables, telephone wires, cable boxes, distribution panels, etc. (E.S.B. 11997/56. Ten/19255.)*

ORDERS PLACED

Durham.—County Education Committee. Accepted. Electrical work in schools:—St. Godrics R.C. School (£866) and Ushaw Moor R.C. School (£733).—R. Robson, Willington. Stockton Technical College (£3,352).—F. H. Wheeler and Co., Ltd. Billingham Technical College, phase 2 (£2,362).—Troughton and Young, Ltd.

Felling (Durham).—U.D.C. Accepted. Lighting equipment and the erection of standards (£4,043).—Concrete Utilities, Ltd.

London.—L.C.C. Accepted. Renewal and improvement of electrical installations and public lighting at Larkhall estate, Wandsworth (£12,140).—London Electricity Board. Renewal and improvement of electrical installation at Sherington County Primary School and Fossdene County Secondary School, Greenwich, and the schoolkeeper's house (£5,385).—Beaufort Electrical Engineering Co., Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Belfast.—Girls' intermediate school, Castlereagh Road; J. V. T. Scott, architect, 30, College Gardens.

College of art in York Street (£400,000); city surveyor, City Hall.

Bishop's Castle.—Secondary modern school; Salop county architect, Column House, London Road, Shrewsbury.

Blaydon.—Houses (50), at Winlaton; U.D.C. surveyor.

Bolton.—Office block, Gilnow Works; Wm. Gornall & Sons, Ltd., Ellesmere Street.

Camberley.—Works and offices for Sharples Centrifuges, Ltd.; J. M. Jones & Sons, Ltd., builders, Highway Works, Maidenhead.

Chelmsford.—Works and offices; County Motor Works (Chelmsford), Ltd., Victoria Road.

Crediton.—Houses (70), Butts Park, for U.D.C.; F. W. Beech and E. Curnow Cooke, architects, 15, Dix's Field, Exeter.

Dundee.—Flats (246), Mains of Fintry; Scottish Special Housing Association, Ltd., 15-21, Palmerston Place, Edinburgh, 12.

Glasgow.—Five-storey departmental stores in Argyle Street; Morrison's Associated Companies, Ltd., 118, Howard Street.

Halesowen.—Factory at Coombs Road/Lodgefield Road; Shotton Bros., Ltd., iron-founders, Manchester Street, Oldbury.

Hatfield.—Residential hotel for students at the Technical College (£50,000); C. H. Aslin, Herts county architect, County Hall, Hertford.

Ipswich.—Eight-storey engineering block, classrooms, assembly hall, offices, etc., as further stage of new civil college scheme (£340,000); East Suffolk county architect, County Hall, Ipswich.

Lanarkshire.—Houses (130), East Parkhead, Bellshill, and houses (56), Muirside, Bailieston; S. McColl, county architect, 23, Beckford Street, Hamilton.

Leeds.—Twelve ten-storey blocks of flats, Moortown, Halton Moor, Ireland Wood and Beckett Park estates; city architect.

Littlehampton.—Works and offices, Lineside Industrial Estate; C.V.A. Jigs, Moulds & Tools, Ltd., Portland Road, Hove.

London.—Dwellings (77), Amhurst Road, Hackney; borough engineer.

Factory and offices, Southwark Street, Walworth; Hatch, Pinner & Co., Ltd., 14a, Farringdon Road, E.C.1.

Houses (186), on three sites, Islington; E. C. P. Monson, architect to B.C., 120, Moorgate Street, E.C.2.

Luton.—Houses (234), Hayhurst Road and Stanton Road; Taylor Woodrow Homes, Ltd., Taywood Road, Greenford.

Newcastle-on-Tyne.—Houses (230), Silver Lonnen, and flats (63), Shields Road (£103,000); city architect.

Scarborough.—Two blocks of three-storey shops, offices and showrooms in St. Thomas Street; O. Garry, architect, 15, Robert Adam Street, Manchester Square, London, W.1.

Sutton Coldfield.—Workshops, offices and stores, Slade Road; Hall & Co., Ltd., Victoria Wharf, Croydon.

Houses (200), Lichfield Park estate; H. Johnson, Ltd., builders, 609, Walsall Road, Birmingham.

Tynemouth.—Factory, Walker Place, for Major Equipment, Ltd.; Wood and Pigg, architects, 17a, Northumberland Square, North Shields.

Houses (51), near Marina Avenue, and two hostels for old people; borough engineer, 16, Northumberland Square, North Shields.

Walsall.—Blocks of shops, flats, schools, clinic, church, etc., in central area, Mossley estate; M. E. Habershon, borough surveyor, Council House.

West Malling.—Houses (104), Ham Hill, Snodland (£139,000), for R.D.C.; T. R. Swann & Son, Ltd., builders, Thomas Road, Sittingbourne.

Weston-super-Mare.—Houses (94), on the Oldmixon estate; R. G. Lickfold, town clerk, Town Hall.

Worksop.—Houses (50), on sites at Harworth and Carlton-in-Lindrick, for R.D.C.; B. Thompson, architect, 83, Bridge Street, Worksop.

Willington (Co. Durham).—Modern school for Durham C.C. (£170,000); G. M. Pearson & Son, builders, Front Street, Hetton.

Wrexham.—Houses (190), Penycae, Broughton, Cefn, Gwersyllt and Rhos; D. E. Edwards, R.D.C. surveyor, Imperial Buildings, Regent Street.